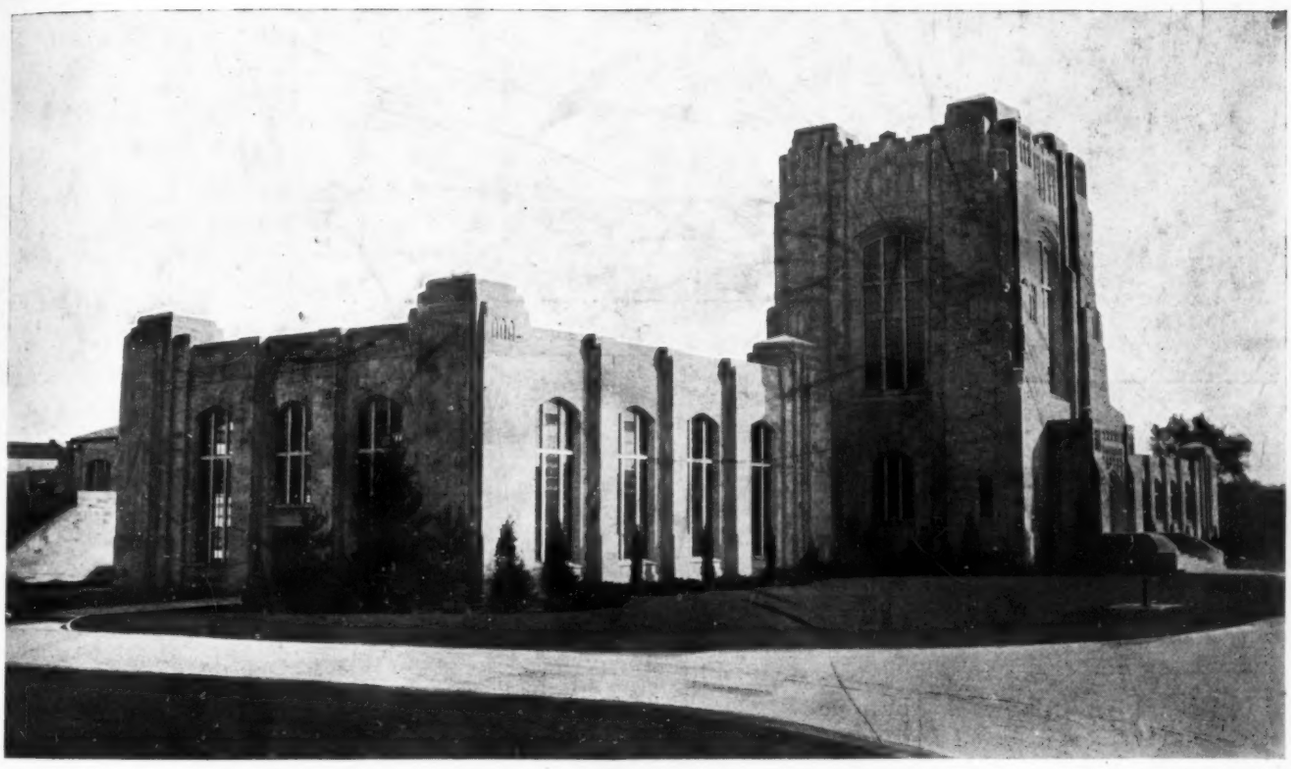
WATER WORKS AND SEWERAGE

December, 1933 — L. H. Enslow, Editor — Vol. LXXX. No. 12



New Pumping Station of Fort Wayne, Ind.; Softening and Filtration Plant in Rear

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Tastes, Chlorine and Chloramines

Methods for the Aeration of Sewage

Fort Wayne Completes Its Water Works

Chemical Treatment of Sewage for Birmingham, Ala.

Improving Settling Tank Efficiencies and Lowering Operating Costs at Aurora, Ill.

Reports of Meetings of Virginia Water and Sewage Works Association; Ohio Conference on Sewage Treatment; and North Carolina Water and Sewage Works Association

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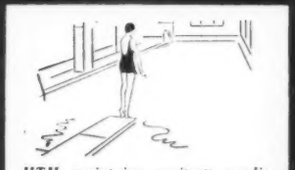

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WATER WORKS & SEWERAGE

L. H. ENSLOW, Editor

LEADING ARTICLES To Appear in the Next and Subsequent Issues:

H. E. Jordan, Sanitary Engineer, Indianapolis Water Company, in the December issue will review the "Advances in Water Supply and Purification Practices" during the year 1933.

Harrison P. Eddy, Consulting Engineer of Boston and President Elect of the American Society of Civil Engineers, contributes a review of "Progress in Sewerage and Sewage Treatment During 1933"—to appear in the February issue.

Joseph Cardillo, Supervisor of Water Service, Lehigh Valley Railroad, Sayre, Pa., will write on boiler water treatment practices with especial reference to methods employed on the Lehigh Valley System and the resulting economies.

John F. Laboon, Consulting Engineer, Pittsburgh, Pa., will describe the many interesting, novel and practical features incorporated in the design of two new sewage treatment plants under construction at Lancaster, Pa.

E. T. Cranch, Manager-Superintendent, New Rochelle Water Company, will describe an ingenuous "Locking Device for Curb Boxes" which he has designed and used effectively to prevent tampering with shut-off service cocks.

Dale L. Maffitt, General Manager of the Des Moines, Ia., Water Department, will discuss the "Measurement of Small Water Flows."

Darwin W. Townsend, Prin. Asst. Engr. Milwaukee Sewerage Commission, will contribute an article covering operating experience and costs of centrifugal dewatering and incineration of screenings and grit at Milwaukee.

W. D. Loreaux, Superintendent of Water Works, Dundee, Mich., had his troubles with tastes and odors caused by beet-sugar wastes and dry weather. He tells how chlorine and activated carbon was employed in dealing with this difficult situation.

C. E. Keefer, Engineer in Charge of Sewage Treatment, Baltimore, Md., will tell of the beneficial results procured from sludge recirculation from bottom to top of digesters.

C. P. Hoover, Superintendent of Water Purification, Columbus, O., will describe a new installation for "Unloading, Handling and Feeding Soda Ash" in water softening practice.

Philip Burgess, Consulting Engineer, Columbus, O., will describe a unique iron removal plant employing contact beds of anthracite coal operated at high rates.

H. H. Hendon, Sanitary Engineer, Birmingham, Ala., will describe the Shades Valley Sewer project involving a 3.5 mile 42-inch trunk sewer, constructed under supervision of a mining engineer, in which a new design of light weight Cast Iron pipe was advantageously employed.

Philip J. Martin, Superintendent of Water Works, Tucson, Ariz., will reveal methods employed in the "Control of Algae and B. Coli in Open Reservoirs" at Tucson.

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Principal Sanitary Chemist, Bureau of Water Supply, Baltimore, Md.

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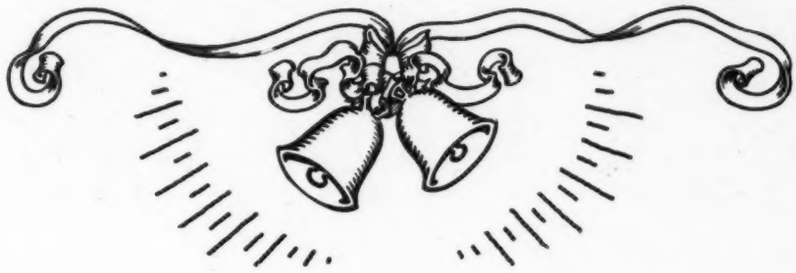

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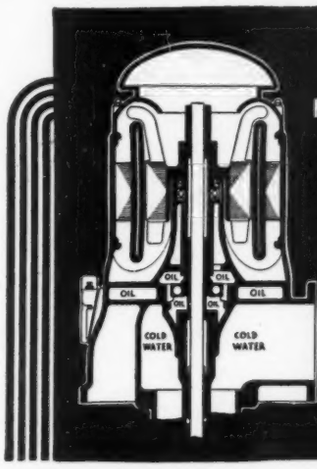

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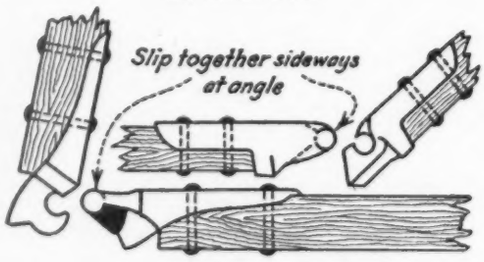

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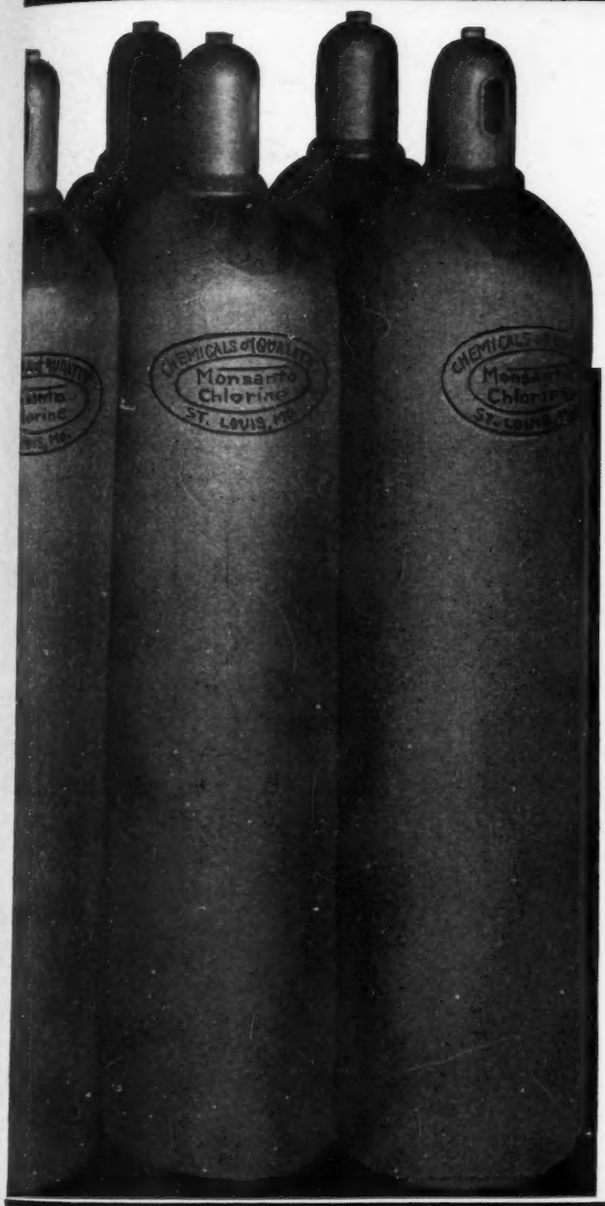

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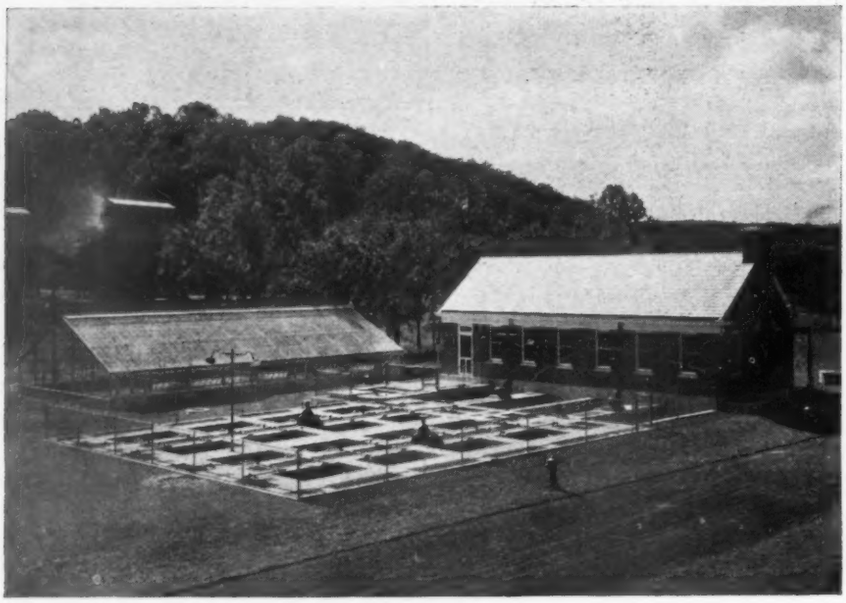

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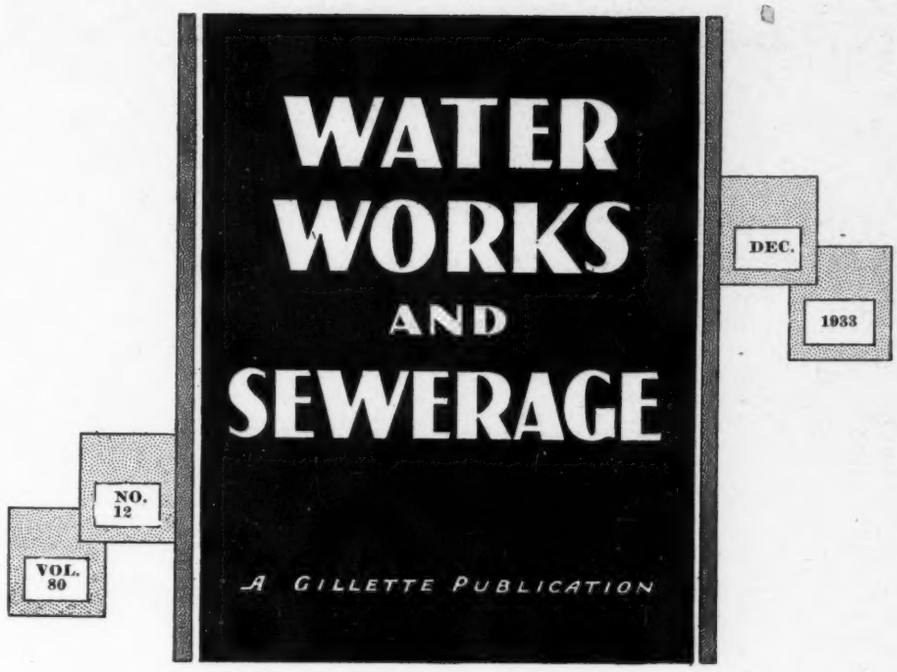


FORT WAYNE COMPLETES ITS WATER WORKS PLANT

By R. L. McNAMEE, C. E.

Hoad, Decker, Shoecraft and Drury
Engineers, Ann Arbor, Mich.

SITUATED at the junction of St. Mary's and St. Joseph's Rivers and at the head of the Maumee River, the principal avenues of trade when the white man first explored the country, the site of Fort Wayne has been an important trading and commercial point for 250 years.

In the early days fire protection for the buildings of the city was provided by pumping from the canal, using long lines of hose. The first water works for the city were constructed in 1880 after a controversy extending over several years. Deep driven wells have served during the 50 years from 1880 to 1930, but within recent years the limitations of these sources of supply have been increasingly apparent.

The Shortcomings of the Well Water Supply

The well water supply is excessively hard, the total hardness varying from about 400 parts per million in some wells to about 750 parts per million in others and averaging about 550 parts per million.

In 1930, following several years of acute water shortage during the summer springling season, engineers were engaged and a report upon the city's water supply system was rendered. Some of the more important facts disclosed by this study were: that the practical yield of the city's present well field had already been reached; and that the drilling of additional wells would not produce water in sufficient additional quantity to justify the expense.

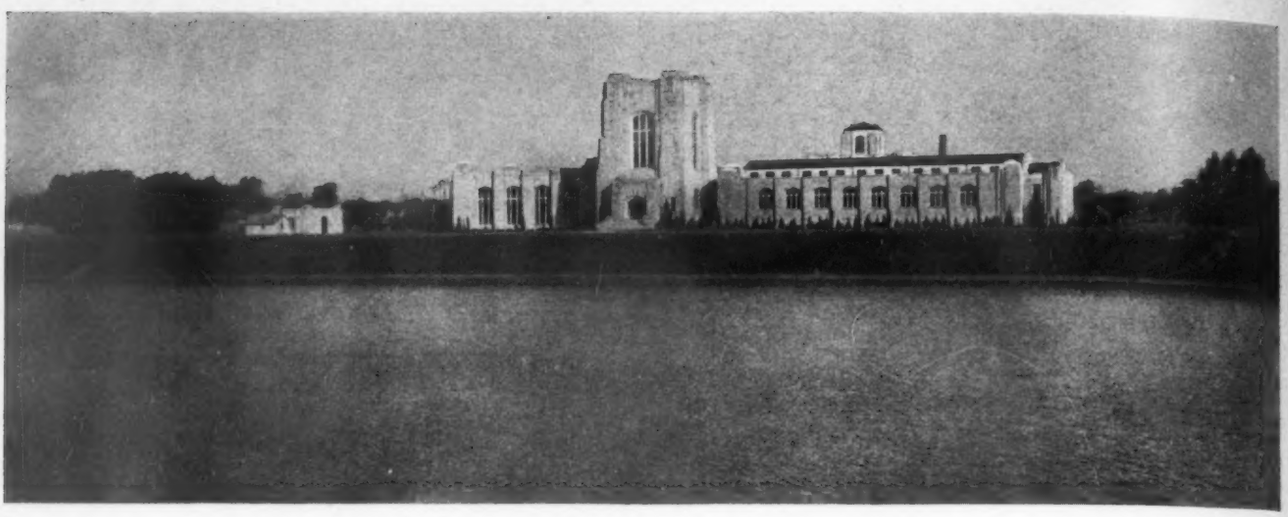
Attention has been given in increasing degree in recent years to the quality of public water supply. The present-day demand is for water free from excessive hardness. Soft water is an absolute requirement in many industries and reasonably soft water is now demanded by the general consumer.

The study of the situation at Fort Wayne disclosed the fact that in recent years there had not been water in sufficient quantity to supply the reasonable demands. The generous use of water on lawns and gardens had been discouraged rather than promoted. Pressures have been inadequate and uneven and industrial use of city water has been comparatively small for one reason or another. These and other circumstances explain the low per capita consumption of Fort Wayne in comparison with other cities in the country—the present average daily use of water being about 86 gallons per capita.

Selection of a Future Source of Water for Fort Wayne

The engineering survey of Fort Wayne's water problem included a careful study of the possibility of securing additional quantities and a better quality of water from the ground. The conclusion reached was: that all water from underground sources in the vicinity of Fort Wayne is extensively hard and much of it contains objectionable quantities of iron; that the large number of wells now being operated by the city and the industries have already developed and are now utilizing about all that the rock well sources can be expected to yield; and that the scattered gravel beds of the region will yield too little water to justify their development.

Attention was then turned to the surface waters of northeastern Indiana. For various reasons the outstanding conclusion was: that the City of Fort Wayne should develop a new source of supply, and that this source should be from the St. Joseph River; that the



View of Plant of Fort Wayne, Ind., Looking Across the River

development of such a supply should provide for the impounding of water in adequate quantities in the river itself, with delivery from the up-river stations to the downtown plant through an aqueduct, and the softening, purification and pumping of water into the distribution system should be from a centrally located station within the city.

It is this plan which the city has followed and which has now culminated in the construction of the St. Joseph River dam and pumping station at the northerly end of Anthony Boulevard, the raw water supply main from this station to the downtown station, and the Three Rivers filtration and pumping station, situated at the junction of the St. Mary and St. Joseph Rivers in Fort Wayne.

Impounding Reservoirs and Pumping Stations

The flow of the St. Joseph River during the dry weather season of the summer occasionally drops to very low rates. The collection of a supply for a city of Fort Wayne's size from a stream of this size and character requires that the flood flows of the stream be collected and held in impounding reservoirs for use during the dry weather season. In the case of the Fort Wayne project, the plan as developed has been to build two dams across the river; the upper one, a large impounding reservoir, and the lower one, a smaller intake reservoir at which point is located the raw water pumping station. At this writing the upper dam, to impound 700 million gallons, has been planned, but is not yet under construction.

The St. Joseph River (lower) dam and pumping station is situated at the northerly end of Anthony Boulevard and the St. Joseph River. The purpose of this unit is to impound a comparatively small volume of water available to the suctions of the raw water pumping equipment. The dam will raise the water level in the river under normal conditions about 10 feet. The dam proper is about 200 feet long with two overflow sections, each 50 feet long and one at each end. Between these are four Tainter gate sections, each with 22 feet clear opening stopped by swinging steel gates. A foot bridge carrying the gate hoist mechanism extends entirely across the dam.

The pumping station, situated at the southeasterly end of the dam, houses the raw water pumping equipment, a hydroelectric turbine and auxiliary equipment. Four pumping units are installed at the present time, three of which are equipped with two-speed motors so that they may be operated at two different discharge capacities. Combinations of these units will provide various pumping rates from about 4,000 gallons per minute up to 22,000 gallons per minute.

The hydroelectric generator is a standard vertical water turbine driving an electric generator with a rated power output of 235 h.p. The power from this source will be applied so far as is available or needed to the operation of the raw water pumping equipment. Any excess power beyond this need will be switched to the transmission lines of the city light and power plant. Shortage of power from this source for the operation of the raw water pumping equipment will be supplied by the city light and power plant.

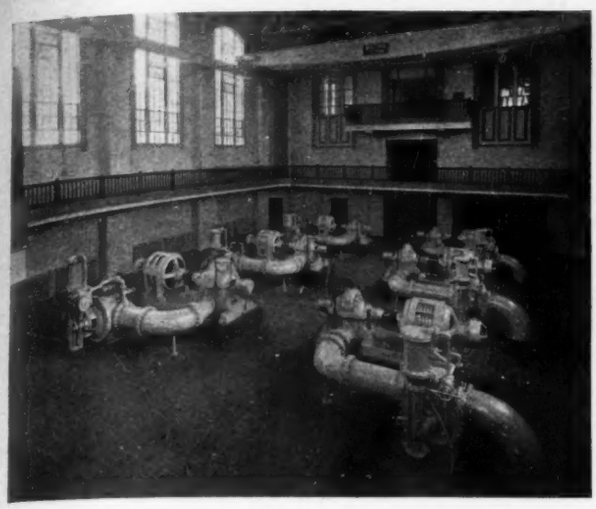
Raw Water Supply Main

The raw water pumps at the St. Joseph pumping station deliver into the raw water supply main, a 42-inch Toncan iron plate pipe connecting the up-river station with the Three Rivers filtration plant. This line is equipped with gates at occasional points, drainage and blow-off lines at low points, air relief valves at high points and access manholes at frequent intervals. Provision has been made in the construction of this line for a parallel line to be laid at some future time when increased water consumption shall require it. The present 42-inch line has a carrying capacity up to 40 million gallons of water per day.

The Three Rivers Softening, Filtration and Pumping Station

The Three Rivers filtration and pumping station is situated at the junction of the St. Joseph and St. Mary Rivers where they form the Maumee in the

New Pumping Station of Fort Wayne, Ind.; Softening and Filtration Plant in Rear



High Service Pump Room, Fort Wayne, Ind.

central part of the city. Here the water is aerated, softened, filtered, sterilized and pumped into the system of underground mains serving all parts of the city. The nominal capacity of the plant is 24 m.g.d.

Aeration.—From the raw water supply main the water may first be passed through aerators. These aerators consist of spray nozzles arranged in two separate basins. They operate effectively over wide ranges of flow and are so designed as to throw the water out in thin sheets thereby providing intimate contact with the air. The water falling from the aerator nozzles is collected upon a sloping concrete floor from which it flows into piping carrying it to the primary mixing tanks. Piping arrangements are provided so that the aeration basins may be bypassed if desired.

Feeding and Handling Chemicals.—The softening of the river water is accomplished by treatment with a commercial grade of ordinary quicklime. For other purposes small amounts of other chemicals may be required. Chemicals and other supplies for the plant may be received in the unloading room in freight cars or in motor trucks. The handling of all chemicals into the plant and through to the point of application to the water is done by a pneumatic conveying system. Essentially it consists of a system of closed piping with intake nozzles on flexible hose lines arranged for use in railroad cars. A partial vacuum is applied to this system of piping by which means chemicals are drawn in and lifted to air filters and separators located in the highest part of the chemical building. Here the dust is filtered from the air, the vacuum is released and the chemicals dropped to one of several storage bins as desired. Two large concrete bins have a holding capacity for lime of 200 tons each. Two smaller steel bins have a holding capacity for lime of 24 tons each. From the smaller bins the lime flows by gravity to the hoppers of feeding machines. These machines, operated by small motors, feed the lime or other reagent into solution hoppers at any predetermined rate. In the solution hoppers the reagent is dissolved or placed in suspension in water in which form it is then discharged into the flowing stream of raw water in the primary mixing tanks.

Mixing Tanks.—The primary mixing tanks are equipped with motor-driven vertical-shaft paddle mechanisms by means of which the water is violently stirred thus accomplishing a thorough mixing of the applied reagents with the raw water. The water to which the reagents have been added then flows into either or both of two batteries of coagulation tanks.

Coagulating Tanks.—Each battery of coagulation tanks consists of a series of three, approximately square, deep tanks in which are mounted motor-driven paddle mechanisms somewhat like those of the mixing tanks. In the coagulation tanks, however, these mechanisms are operated much more slowly, their purpose being to promote a thorough but gentle stirring of the water. During the time which the water requires to flow through the three coagulation tanks, approximately 45 minutes at the nominal rate of 24 million gallons per day, the interaction of the applied reagents with the mineral constituents of the raw water is completed. These reactions result in the formation of insoluble precipitates which are later to be removed from the water by settling.

Primary Classification Tanks.—These tanks, two in number, are provided to settle out the bulk of insoluble matter resulting from the interaction of applied chemicals with the mineral constituents of the raw water. Each tank is equipped with a motor-driven scraper mechanism by means of which the settled precipitates, or sludge as it is commonly termed, can be continuously plowed to a central sump. From this sump the sludge is pumped to the drain. The clarified water, now containing but a small part of the chemicals applied to it and the mineral constituents originally carried by it, flows into settling basins.

Settling Basins.—Much larger than the clarification tanks, the settling basins allow practically all of the precipitate not removed in the clarification tanks settle out. These basins provide a detention period of about 4 hours. The settled material collected in the bottom of these tanks may be drawn or pumped to waste. The water from which practically all of the applied reagents and the original mineral constituents have now been removed flows next into carbonation tanks.

Carbonation Tanks.—In the carbonation tanks the water during a flowing period of about 9 minutes is treated with carbon dioxide gas, which is generated in the boiler room of the plant by a coke-gas process. The coke gas is burned under the plant heating boilers in such manner as to produce a stack gas containing carbon dioxide. This stack gas thoroughly cleansed is compressed and discharged through diffuser piping in the bottom of carbonation tanks. This process supplies, as a by-product, practically all the heat for the station buildings. In the carbona-

Aerators in Action, Fort Wayne Softening and Filtration Plant

Operating Gallery, Fort Wayne Filtration Plant

tion tanks the carbon dioxide gas bubbles up slowly through the 14 feet depth of water. This process completes the softening reaction and serves to improve the appearance and taste of the water. From the carbonation tanks the water next flows to the filters.

Filters.—There are ten filter units each having a

plant through its massive elements and dignified lines.

Operating Personnel

The city's new water supply system, consisting of the up-river dams, the raw water supply, mains and

CHEMICAL TREATMENT OF SEWAGE FOR BIRMINGHAM, ALA.

Flexibility of Plant Design Stressed

By H. H. HENDON

Engineer in Charge of Sewerage and Sewage Treatment, Jefferson County, Ala., Birmingham, Ala.

IN recent years there has been a revival of interest in the chemical treatment of sewage, particularly along the line of supplementing other processes, or as a purification process yielding results intermediate between sedimentation and complete biological treatment. There are to date approximately ten patented processes being demonsrated in experimental units throughout the country. This renewed interest is due to many things, some of which may be listed as follows: improved methods of control; improved methods of preliminary treatment; improved methods of manufacture, with the resulting reduction in cost of chemicals; and the realization on the part of the sanitary engineer that complete treatment is not in every case necessary.

In the project under discussion there were several conditions that lent attraction to a chemical process as being preferable to biological treatment. The use of "chlorinated-copperas" as a possible coagulant was suggested to the author by L. H. Enslow. This scheme was investigated by the writer and a demonstration unit was operated before the process was selected.

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The Shades Valley Project

The Birmingham District lies in four drainage areas. The smallest of which is the Shades Creek area popularly known as Shades Valley, bounded on the north by Red Mountain and on the south by Shades Mountain.

This valley is about three miles wide, and that part of it under discussion is twelve miles long. Centrally located in this area is the city of Homewood, which is about 60 per cent built up. Just east of Homewood is the Birmingham Country Club, the Mountain Brook Country Club, the Mountain Brook residential district and the Redmont Park residential district. These are the most exclusive residential sections in the Birmingham district, the residential lots ranging in size from one to five acres. Several miles further east is the town of Irondale, a small town that has no sanitary sewers. The intervening area is mostly laid out in high class residential lots, but to date undeveloped. For the past ten years there has been a constant exodus of people out of Birmingham into Shades Valley and this area is the most rapidly growing section of the district.

Shades Creek runs west down the center of this valley and is a very beautiful winding stream. This stream, now free of pollution, will probably be completely developed into public parks and recreational centers in the

Utilization of Sewage Sludge Gas for Refrigeration

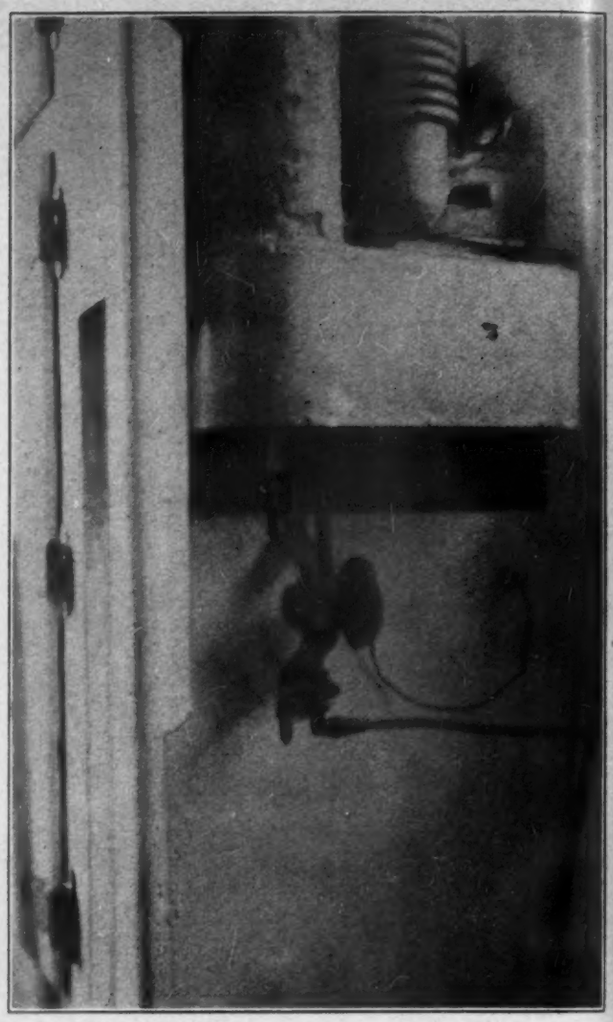
BY GUY E. GRIFFIN

Supt., Sewage Treatment Plants, Greenwich, Conn.

AT Greenwich, sludge digester gas at the Sewage Treatment Works is used for heating and also for cooling.

In June, 1933, we installed in our laboratory at the new plant, serving Old Greenwich, a 6 cu. ft. capacity, water cooled Electrolux refrigerator. We saw no reason to purchase ice or electricity for refrigeration as long as it appeared possible to operate a refrigerator on gas from our sludge digestion tank.

We had previously experimented in the laboratory with a burner, from an Electrolux gas operated refrigerator, to prove to our satisfaction that it would operate properly on sludge gas. We soon discovered that, because of the characteristics of sludge gas and because pressures differed from those on city gas mains, a few changes in the burner would be required. We found it necessary to enlarge the burner orifice to about one-eighth inch diameter and also discovered that best results were obtained by removing the flame spreader cap from the top of the burner. By doing so the flame would burn in a single cone as it does from the efficient laboratory type Bunsen burners. We discovered further that decreasing the length of the burner tube, from the original 2½ inch length, to 1½ inches allowed the flame to make contact with the safety diaphragm valve at all times even though the gas pressure varied between ½ inch and 3½ inches of water head. Before making this change the lower pressure was not sufficient to keep the mechanism sufficiently hot and this resulted in the diaphragm valve cooling sufficiently to shut off the gas flow at times.



Burner of the Electrolux Refrigerator, Slightly Redesigned by the Author to Burn Sludge Gas Satisfactorily

An Electrolux Laboratory Refrigerator Operating on Sludge Gas at the New Sewage Treatment Plant, Greenwich, Conn. (The Author of This Article Is Shown Checking the Temperature.)

With these few minor changes to the burner the refrigerator has operated perfectly, maintaining a temperature of 40 to 45 degrees Fahrenheit for the past six months. The amount of gas used is less than will register on our flow meters—probably about 5 cu. ft. per hour. A measurement of the amount of water used for cooling indicated a consumption of 140 gallons per day during the summer and somewhat less will be required during the winter. Now, however, with the improved air cooled Electrolux no water will be required.

The installation of this refrigerator, by eliminating the ice man, has meant a saving of $6 to $8 a month in the operation of our new laboratory which serves four sewage treatment plants. As a matter of interest the writer has frozen ice cream in the cube trays.

I wonder if anyone else has utilized sewage sludge gas for such a purpose! If not, the scheme is worthy of consideration.

CHEMICAL TREATMENT OF SEWAGE FOR BIRMINGHAM, ALA.

Flexibility of Plant Design Stressed

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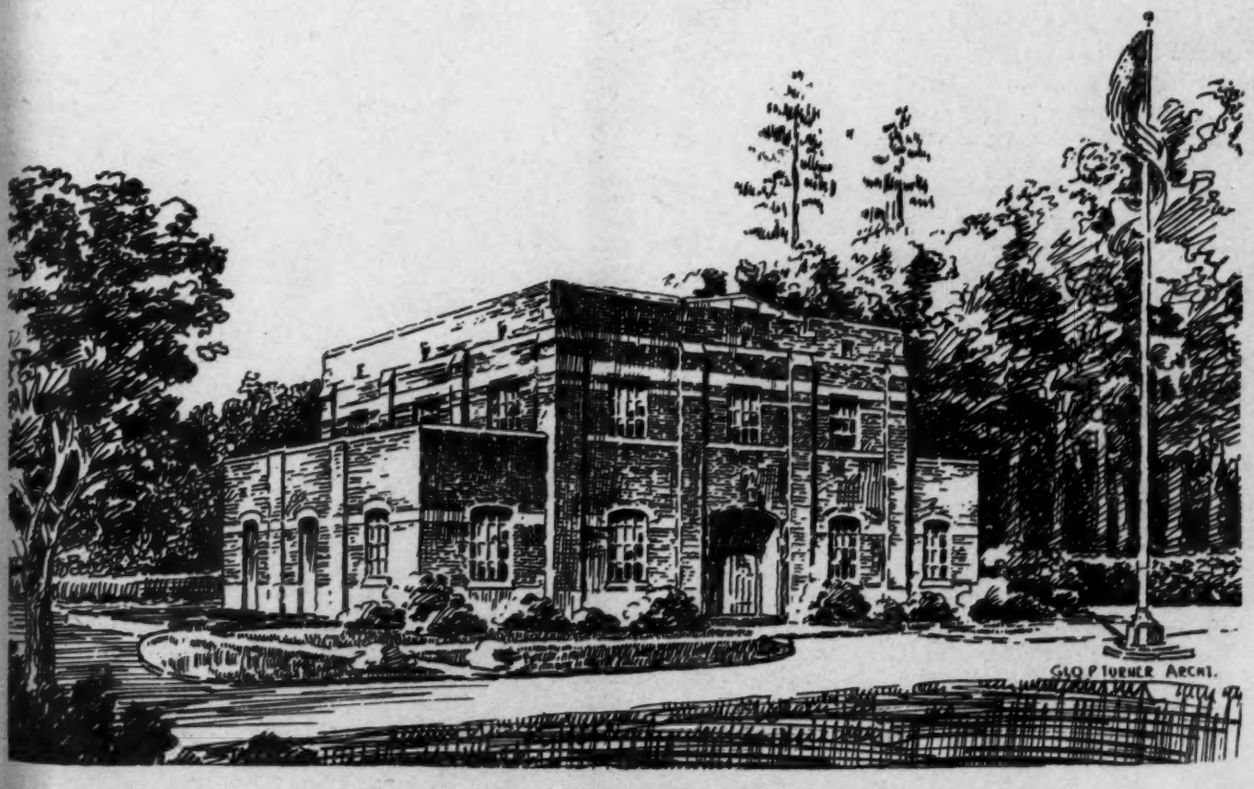


Shades Valley Sewage Treatment Plant, Birmingham, Ala.

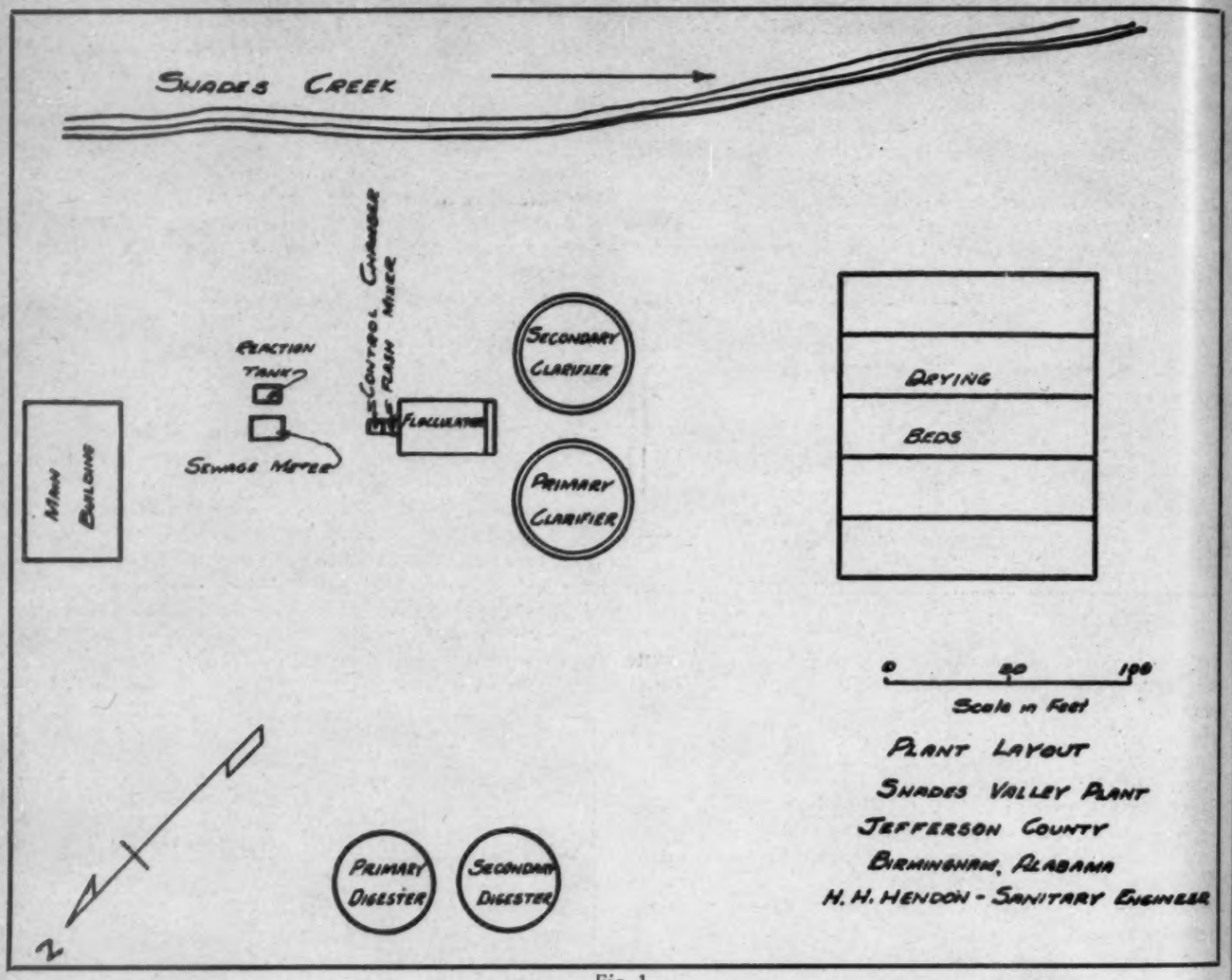


Fig. 1

along this line into a golf course, bridle paths and a lake for boating and swimming.

In 1928, Jefferson County and the municipalities lying within the drainage area started construction of sanitary sewers for the area and the county is now starting construction of a plant to treat this sewage.

The population figures used in the design of this plant are shown in the following table. These figures were taken from the Southern Bell Tel. & Tel. Co. survey and forecast, as follows:

Year.	*Population,*
1920	4,650
1927	7,812
1947	30,443

At the present time, there are approximately 1,500 people connected to the sewer system; however, the completion of additional county sewers in this drainage area will add an additional 750 people immediately, and another 1,000 people will be added when the Hollywood section is sewered, probably within the next twelve months.

The above forecast and rate of population increase was made during a period of very rapid expansion for the section. However, since that time, owing to present economic conditions, the annual increments have been retarded, therefore the forecast for 1947 was discounted approximately twenty-five per cent.

On this basis the total population in the year 1948 (15 years hence) will be about 22,000. For the purpose of the design of the plant, it was assumed that 70 per cent, or 15,000 people, would be connected to the sewer by that time. Assuming 100 gallons per capita per day, this would give a flow of 1.5 m.g.d. to which there has been added 0.5 m.g.d. for existing infiltration, giving an estimated flow of 2 m.g.d. used in plant design. The present dry weather flow of the sewer is but 0.5 m.g.d., and the present wet weather flow is 1.75 m.g.d.

Selection of a Treatment Process

Shades Creek is a stream that has a large flow in the wet months and an unusually small flow in the dry months. This small flow is made even more acute by evaporation in a relatively large lake one mile above the plant site. During the wet months this stream can carry the organic load from the above sewage without nuisance if the visible solids are removed by screening or a short period of sedimentation. However, due to the fact that for several miles below the proposed plant this stream is extensively used for recreational purposes, some scheme of sterilization is desirable at all times except during the extremely cold months.

To solve the above problem, there are only two well established processes of sewage treatment available, namely, activated sludge and sprinkling filters. Due to the high operating costs for a small plant and patent complications, the activated sludge process was eliminated. Based upon laboratory studies by the Sanitary Engineering Department and upon similar experiments throughout the country, a chemical precipitation plant

was selected in preference to a sprinkling filter plant. This decision was based upon the following facts:

1. The strength of domestic sewage from this area, in terms of biochemical oxygen demand, varies from approximately 400 parts per million at the peak daytime load to approximately 40 parts per million at the minimum early morning load. At the same time the volume of sewage varies in the ratio of about 1 to 2. These variations in strength and volume occur at the same time throughout the daily cycle, giving a total amount of work to be done by the treatment works at the peak of the daily cycle of approximately twenty times that done at

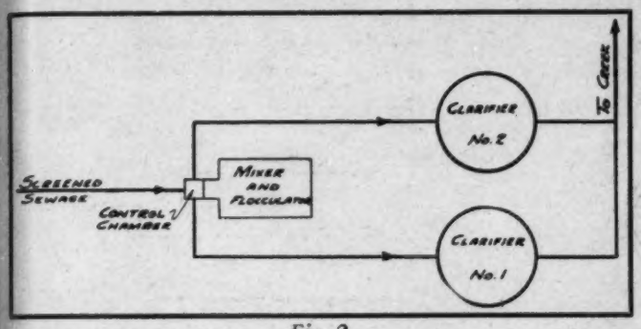


Fig. 2

the minimum. This condition is made even more acute by variation in weather conditions. A sprinkling filter should be built to treat the maximum conditions stated above, therefore during minimum conditions it would be operating at approximately 5 to 10 per cent loading, while with the chemical process the work done by the plant can be very easily and quickly adapted to variations in requirements by adjusting the chemical dosage.

2. Since complete treatment is unnecessary during wet seasons, it is desirable that the plant be capable of being changed from primary to complete treatment easily, quickly and at the least over all cost of treatment.

3. The rapidly increasing population load would require, with sprinkling filters, the continual adding of units or the building of an unnecessarily large filter at this time.

4. The relatively weak sewage from this drainage area would require large filter areas out of proportion to the amount of organic matter removed.

5. The problem of odors and fly breeding usually ac-

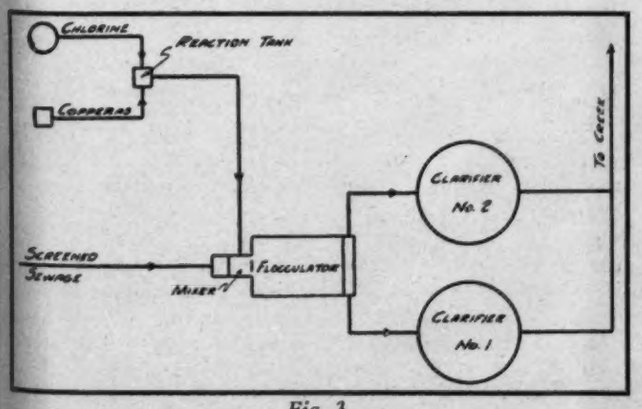


Fig. 3

companying a sprinkling filter plant is not met with when employing chemical processes. An important consideration in a resident district.

6. By using a chemical process it is possible to obtain a gravity flow through the plant while filters would require the installation of a pumping station to gain the required head.

7. The cost of a chemical plant would be only approximately 60 per cent the cost of a sprinkling filter plant and would require about one-half the area.

Attractive structures and landscape effects are better obtained with chemical treatment than with trickling filters.

It is essential that chlorination be included as a part of any process of treatment selected. With ferrous sulphate obtainable in this district from the local steel mills at a very reasonable price and since chlorine is to be used in any case, the chlorinated copperas process was selected. The estimated cost of these chemicals, delivered at the plant, for the treatment, is approximately five dollars per million gallons of sewage treated.

The chlorine required for sterilization is to be fed into the settled sewage along with the chlorine required to make the chlorinated copperas.

Flexibility the Chief Aim in Design of Plant

The plant consists of a sewage meter, flash mixer, slow mixer or flocculator, two settling tanks or clarifiers, two sludge digesters, five sludge drying beds, and a main building housing the following: bar screen, two chlorinators, chlorine scales, two dry feed machines, two sludge pumps, two water pumps, digester heating equipment, shop room, and on the second floor a chemical storage room, a laboratory, and a small office. The relative location of these units is shown on Figure 1.

To meet requirements the plant is so laid out that it

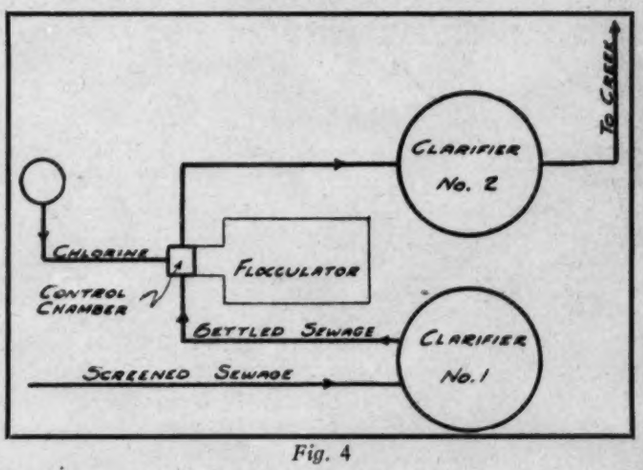


Fig. 4

can be operated in six different ways. Each of these operation schemes are here illustrated by schematic drawings briefly described.

Scheme 1 (See Fig 2)

In this scheme, the screened sewage is treated by plain sedimentation. The mixer and flocculator are by-passed and one-half of the sewage is run through each clarifier. This scheme will treat up to four million gallons per day and will be used during the winter months.

Scheme 2 (See Fig. 2)

For storm flows, in the summer months, chlorine alone can be added to the raw sewage at the control chamber or to the settled sewage.

Scheme 3 (See Fig. 3)

In this scheme, chlorinated copperas and free chlorine are added to the screened sewage entering the rapid mixer. The sewage then passes through the coagulating flocculator and settling tanks. Should it be desirable, this scheme can be used to treat storm flows; however it is doubtful that the plant will ever be operated as a precipitation plant in this manner (settling tanks in paral-

lel). Four million gallons per day can be treated in this manner.

Scheme 4 (See Fig. 4)

In this scheme, the mixer and flocculator are by-passed. The screened sewage is run first through one clarifier and then chlorine is applied to the settled sewage and the second clarifier is used as a contact tank. This scheme will treat up to three million gallons per day.

Scheme 5 (See Fig. 5)

In this scheme, the screened sewage is run first through the primary clarifier. The settled sewage then returns to the rapid mixer where chlorinated copperas and free

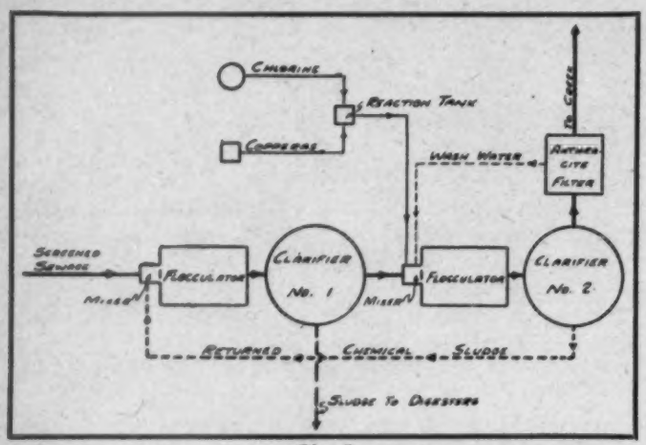


Fig. 5

chlorine are added. It then flows through the flocculator and secondary clarifier. This scheme will treat up to two million gallons per day.

Scheme 6 (See Fig. 6)

There is a division wall in the flocculator which allows it to be used as two separate units. In this scheme, the screened sewage flows first into one side of the flocculator where the chemical sludge, pumped from the secondary clarifier, is continuously mixed with it. This mixture then flows into the primary clarifier. The settled sewage then flows back to the mixer where chlorinated copperas and free chlorine are added. It then flows through the other half of the flocculator and into the secondary clarifier.

The returning of chemical sludge to the raw sewage has two advantages, first, it will increase the efficiency of the primary sedimentation or in other words a more efficient use of the chemicals is obtained, and second, it will give a uniform mixture of crude and chemical sludge deliveries to the digesters.

The two clarifiers shown are at the same elevation to obtain the parallel operation shown in schemes 1, 2 and 3, therefore for series operation it is necessary to overcome the friction losses from the control chamber through the primary clarifier and back to the control chamber as shown in schemes 4, 5 and 6. This was accomplished by designing the flash mixer to act as a pump or lifting device to raise the sewage approximately one foot.

Filtration of Effluent

The rapid mechanical filter shown is planned to remove the fine floc that will not settle in the secondary clarifier. It will be operated at a high rate of four gallons per square foot per minute or more. Ground anthracite coal is to be used as the filter bed for two reasons; first, the smaller amount of wash water required to float the bed and second, greases can be removed with caustic. Filtered effluent will be used for wash water and the dirty water will be returned to the raw sewage.

The sludge from this process will be digested in two stages. The first stage in a mechanical, heated tank and second stage in a plain, unheated tank. Gas will be collected from both tanks and utilized in the plant. The digested sludge will be dried on open drying beds.

In the above discussion, in comparing treatment processes, it was assumed that a sprinkling filter plant would give 85 to 90 per cent purification, measured in terms of biochemical oxygen demand, and that the chemical precipitation plant would give 70 to 75 per cent purification by precipitation and an additional 10 to 15 per cent by chlorination.

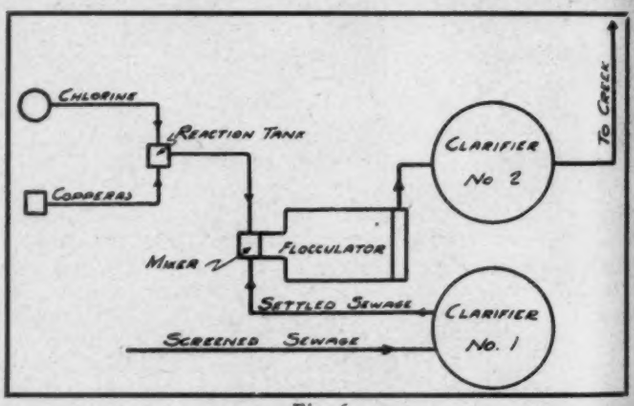


Fig. 6

The writer takes this opportunity to express his appreciation to Wellington Donaldson of the firm of Fuller and McClintock, New York City; A. Clinton Decker, Sanitary Engineer, Tennessee Coal, Iron and Railroad Company, Birmingham, Alabama; and R. S. Rankin, Sanitary Engineer of the Dorr Company, New York City, for their many valuable suggestions in the design of this plant.

This plant, designed by the author, is now under construction except for the anthracite filter and will be put in operation early in the spring of 1934. Fuller and McClintock, of New York City, served as Consulting Engineers on the project.

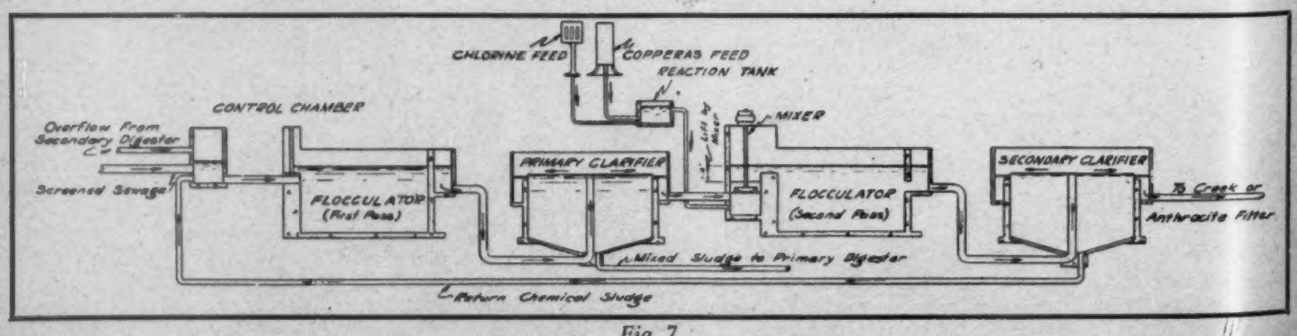


Fig. 7

MEETING OF THE VIRGINIA WATER AND SEWAGE WORKS ASSOCIATION

THE Virginia Water and Sewage Works Association, which met in Newport News, Va., November 16-18, 1933, was attended by approximately 150 members and guests, 125 of which registered for the meeting.

A feature of the meeting was the "Open Discussion of the P.W.A. Methods of Financing Water Works and Sewerage Projects" and the presentation of the Civil Works Administration's program, indicating how the two dove-tailed, by Morton L. Wallerstein, Secretary, Virginia League of Municipalities. This session was attended by Col. J. A. Anderson, State Engineer for the P.W.A., who answered questions and clarified certain points brought up in the discussion. During the meeting the State Advisory Board was in session in adjoining rooms in order that matters could be brought before its members for action during the meeting.

Of importance to tide-water Virginia cities, was the announcement concerning the establishment of the Chesapeake Bay Authority and the proposed program of sanitation which would uniformly affect all cities on this body of water, the P.W.A. having allotted to the U. S. Public Health Service $25,000 for making the necessary preliminary survey for the purpose of determining the extent and degree of sewage and waste treatment required to eliminate objectionable pollution of the waters of the great Chesapeake Bay and its back waters.

W. F. DAY, City Manager, Staunton, Va., reported to the Association information gained by him in Washington in respect to the new Civil Works Administration program, for which $400,000,000 has been allotted by the P.W.A. to be used as an outright grant to get employment on Public Works under way the country over during the period when construction on P.W.A. projects was being gotten into full swing. Virginia's share, based on population and the number of relief cases reported, would be $5,000,000, and without strings or red tape attached.

MR. WALLERSTEIN explained that the C.W.A. program would in no wise interfere with, but was merely a supplement to, the P.W.A. program, the rates paid for labor and hours of work being identical. He said that such things as sewer and water main extensions, repairs, painting and all forms of maintenance work could be pushed forward. Funds could only be used for paying for labor but the materials could be bought with money released from the Work Relief Fund, provided for already by most cities.

To a question, Col. Anderson, State Engineer, replied that municipalities so bad off financially as not to be able to finance water and sewage projects through P.W.A. channels would be permitted to use Civil Works funds for labor employed on major projects including new water or sewerage systems or treatment works.

The Association Votes to Become a Section of the A. W. W. A.

An action of primary interest was that taken by the Association when, following a talk by Beekman C. Little, Secretary of the A.W.W.A., outlining the advantages to be gained through affiliation of the Virginia group with the American Water Works Association and supporting speeches by leading members, the Association voted unanimously to apply for a charter as the Virginia Section of the A.W.W.A.

Contingent, upon acceptance by the A.W.W.A. the Association then elected as the first A.W.W.A. Director to represent the Section, Eugene F. Dugger, Manager of the Newport News Water Department and retiring Chairman of the Association.

New Officers

The following were elected to offices for the ensuing year:

Chairman: B. S. Parrish, Supt., Public Works, Martinsville, Va.
Vice-Chairman: D. R. Taylor, Supt., Roanoke Water Co., Roanoke, Va.
Secretary: H. W. Snidow, State Department Health, Richmond, Va.
Treasurer: C. F. Bingham, Supt., Filtration, Richmond, Va.
Executive Committee: E. F. Dugger, W. F. Cocke, M. C. Smith.

Martinsville, Va., made a strong bid for the Convention in 1934 and the invitation was accepted.

Annual Banquet

Those attending the meeting were banquet guests of the city of Newport News. Mayor R. W. West made an appropriate address of welcome—a very brief and witty one—in which he did not fail to say nice things about their Eugene Dugger.

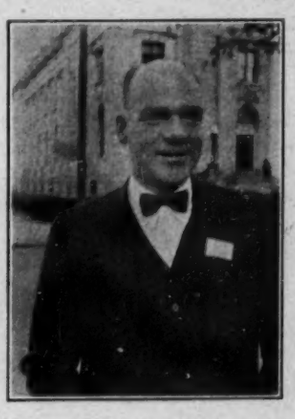
Technical Sessions*

(Chairman: E. F. Dugger presiding)

"The Newport News Water Supply"—J. C. BIGGINS, City Manager, Newport News, Va.

Mr. Biggins reviewed the history of the water supply of the city which had been purchased from a private company in 1926 for $3,900,000, in which was included 10,000 acres of water-shed area. Control of the water-shed had proven a particularly valuable asset, he said, during the 1931 drought. The Water Department (Commission) was operating at a profit and had spent

E. F. Dugger, Newport News, Va., Retiring Chairman; Director of the Association



B. S. Parrish, Martinsville, Va., Chairman-Elect

*(Note: Not all of the papers read can be covered in the space available in this issue and therefore several will be carried forward to the next issue.—Editor.)

$400,000 in replacement and retired large blocks of bonds from revenues. Rates had remained exactly what they were when the system was purchased 7 years ago—those for consumers outside of the city limits being 10 per cent higher than city rates. The Commission had applied for P.W.A. loan of $197,000 for replacement of small mains, for extensions and for an elevated service tank. An additional $115,000 was to be put into other

C. F. Bingham, Superintendent of Filtration, Richmond, Va., Treasurer of the Association

Richard Messer, Chief Engineer, State Department of Health, Richmond, Va.

improvements. Contracts had been drawn pending receipt of allotments from the P.W.A.

Symposium on Tastes and Odors

"Taste and Odor Control Experiences"—R. W. Fitzgerald, Chief Chemist, Bureau of Water, Norfolk, Va.

Mr. Fitzgerald reviewed the trying experiences in taste and odor correction at the two Norfolk filtration plants. The difficulties had been due primarily to decomposition of organic matter and algae growths in the shallow impounding reservoirs.

The highly putrefactive sludge depositing in the coagulating basins had also contributed its share of trouble and prior to corrective treatment all basins had to be cleaned each two weeks or sludge would rise to the surface in summer. The use of ammonia-chlorine treatment and pre-chlorination at the reservoir (Lake Prince) had been the most successful remedy prior to the advent of powdered carbon. "Nuchar" came into the picture in 1931 and had yielded the most successful results of any material used. Dosages, continuously applied, at an average of 0.1 gr./gal. to the raw water had been 90 per cent effective in taste elimination and had kept down the troublesome sludge putrefaction in the basins. In times of extreme conditions carbon is also applied to the filter influent and even after the hurricane of August which had turned over the lakes (requiring 7 gr./gal. of alum for color removal of 120 p.p.m.) when tastes could not be removed by the carbon applied to the raw water alone, an application of an additional 3 p.p.m. at the filters had been effective. Filters were choked quickly but jolting the beds at 6 ft. head loss had caused a drop to 3 ft. loss and extended runs—a temporary nuisance, but carbon did the work.

Howard A. Johnson, Superintendent of Filtration, Danville, Va., unable to attend the meeting, sent in a prepared discussion. He related his experiences with ammonia-chlorine treatment of the Dan River water. It had not been entirely effective in taste elimination but had proven a very satisfactory treatment for controlling aftergrowths and algae in reservoirs. Later, prechlorination and activated carbon had been used. Particularly bad conditions in 1933 had required 40 lbs. of "Nuchar" per m.g.—the point of application being between two coagulating basins connected in series. Applied directly to the filters not more than 10 lbs./mg. had been permissible without choking the filters badly. The cost of normal dosages required between the basins had averaged 23.4 cents per m.g., whereas during the 40 lb. dosage, intermittently required, the cost had risen to $2.62 per m.g.

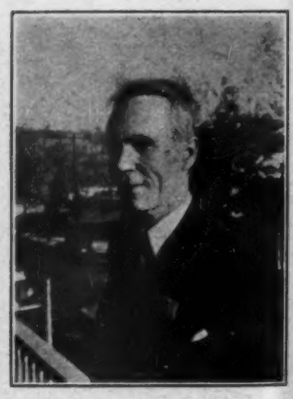
S. B. Parrish of Martinsville said that spotting taste complaints on their distribution system map had shown up some interesting facts and served to indicate the trouble spots and the need of flushing at definite points.

Mr. Fritzgerald remarked that complaints were always more prevalent at far ends of the system whereas the water had been in good shape closer to the plant.

A. C. Walton, Chief of Service, Dept. of Water Supply, Richmond, Va., said that he had employed quite an elaborate scheme of complaint spotting on distribution maps with colored pins. (Red pins—red water; black pins—black water; blue pins—bad taste, etc.) He had found flushing of the mains to be of temporary relief only, sometimes the cure being worse than the disease. Since the use of heavy prechlorination and activated carbon ahead of the filters, improved coagulation, and in addition, ammonia chlorine treatment of the filtered water there had been so few complaints in Richmond that the spot chart had been neglected during this year. Flushing of mains had been practically unnecessary recently and some of the water was estimated to be 28 days older, than when treated, before it reached the consumer's tap. That was an extreme case on a large main (privately owned) supplying a real estate development some distance out.

L. H. Enslow explained the probable cause for dead end taste and odor complaints, red water or more likely black water at such points in summer. Decomposition of organic deposits in the dead ends seemed to take place in warm weather. The chlorine effect having played out the aftergrowth of bacteria had seemed to go on profusely. Then, if some residual chlorine did reach the bad water in dead ends, at times, a highly medicated taste was produced. Now, however, with the use of carbon

R. W. Fitzgerald, Chief Chemist, Bureau of Water Supply, Norfolk, Va.



A. C. Walton, Chief of Service, Water Department, Richmond, Va.

to remove tastes and most of the organic matter, at the plant, and the use of ammonia and chlorine in the effluent, residual chlorine then persisting to the far ends of the system held the bacterial decomposition in check—result: putrefaction, corrosion and resultant products of decay, including sulphide of hydrogen which produces the black water so frequently observed in main flushing, had been held in check if not prevented. Heavy pre-

chlorination such as that practiced at Richmond had proven effective elsewhere, since, to destroy by oxidation much of the organic matter otherwise passing through the plant. The carbon removed excess chlorine and much of the unattacked organic matter also, including taste producing compounds. The method of carbon use at Richmond was both novel and economical.

In reply to a question from the floor, F. E. STUART,

C. C. Massey, City Engineer, Fredericksburg, Va.

C. L. Crockett, Chemist, N. & W. Ry., Roanoke, Va.

of the Industrial Chemical Sales Company, stated that powdered carbon application to raw water seemed to definitely assist coagulation when turbidity was deficient. A survey had indicated that 68 per cent of the plants apply some carbon, if not all of it, in the coagulation process and several mix the carbon with the coagulant. He referred to the new coagulant, "Blackalum," which contained powdered carbon to an extent providing 120 billion particles of carbon per pound of alum. Only 2 per cent of "Nuchar" carbon by weight was involved, however, and this small quantity while effective in sludge stabilization would have to be supplemented by further additions for complete taste control in many instances.

He was in agreement that prechlorination assisted performance by activated carbon. This scheme followed by post chlorination and ammonia was the surest process yet devised to insure super-safety and positive taste and odor control. Richmond had been the first plant to adopt this procedure and others had followed the lead with satisfying results.

EUGENE DUGGER remarked that the Newport News plant had been among the earliest to use the powdered carbon process, which had continued to prove a highly effective scheme of taste control.

"Consumers' Complaints and Methods of Handling Them"—C. C. MASSEY, City Engineer, Fredericksburg, Va.

The chief complaints at Fredericksburg had been brought on by deficient pressures due to corroded ½ inch G. I. service lines. The solution had been replacements with larger pipe. Between the main and curb line the city had stood the cost and the consumer paid for the remainder of the line, but it had proven highly important to have a clear cut understanding between the Water Department and consumer before making such changes. In some instances replacement of small mains had been required since reduced pressures (40 lbs.) on the distribution system had been carried except during fires. Sewer complaints had been from stoppages mostly by tree roots entering defective joints.

In reply to a question, Mr. Massey stated that since raising the pH of the water with lime the G. I. services had not been corroded.

A. C. WALTON stated that the complaints in Richmond were now chiefly from small consumers objecting to the size of the bill.

E. H. RUEHL, Town Manager, Bluefield, Va., related instances of complaints resulting from larger bills due to water consumed by gas refrigerators.

H. E. BECKWITH said that a good argument for consumers complaining of water bills was to compare the cost of water per ton with other materials, such as dirt even. One would find that water is sold at about 6 to 8 per cent the cost of dirt, ton for ton. If dirt was next to the cheapest thing in the world then water was certainly the cheapest.

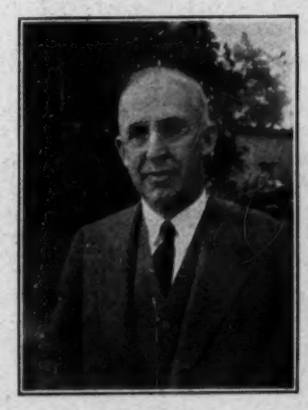
Water Softening Practices

"Methods of Water Softening"—C. P. HOOVER, Consulting Chemical Engineer, Columbus, O.

Mr. Hoover, a pioneer in water softening practice in America, in his usual interesting manner discussed the high lights of present day water softening practice. He said that few people realize that it costs real money to soften water with soap but that was exactly what everyone did when they used hard water for washing or bathing. This, at a cost of $3.00 worth of soap (20 lbs.) as compared with one half cents worth of lime to do the same job in a softening plant. He cited examples to show that $3.75 to $7.50 was the annual per capita soap bills in cities using fairly soft to hard water—the lower figure being that for a water supply of 45 parts hardness and the highest for a city of fairly hard water. By difference the hardwater city taxpayer was spending $15.00 a year needlessly for soap for a household of four people, besides the several other disadvantages of the hard water, such as plumber's bill to replace choked up water backs and piping.

Recent practice had been in the direction of softening all waters of 150 parts hardness or more and existing filtration plants with facilities added for chemical handling were readily converted into softening plants. Softening represented the safest purification practice in that it produced large bulky precipitates, long filter runs and a non-corrosive water free of iron and manganese.

Upwards of 100 softening plants for municipalities had



Chas. P. Hoover, Chemical Engineer, Columbus, O.

R. C. Bardwell, Superintendent, Water Supply, C. & O. Ry., Richmond, Va.

been built during the past 10 years, many of which used zeolite softening alone or in combination with the lime soda process. He described the mechanism of each and reasons for the combination. He discussed the development of recarbonation to precipitate colloidal lime salts and avoid incrustation of the mains, meters and services. The first carbonation, applied shortly after coagulation, should reduce the pH to 9.4 to 9.6 at which point the

carbonate of calcium was least soluble and only after a primary settling should more carbon dioxide be added to reduce the pH to between 8.3 and 8.5 in order to produce a very mildly depositing and non-corrosive water. In lieu of secondary settling the final CO_2 application might be made to the filtered water.

Mr. Hoover in comparing the lime or lime and soda process with the zeolite process said that the sludge nuisance did not appear in the last named but the cost of lime to remove the carbonate or temporary hardness was just about one half the cost of salt for operating zeolite filters, whereas in removing permanent hardness (chlorides and sulphates) the salt required cost 20 per cent less than soda ash for the purpose. In the final analysis both processes have their merits and a place, the selection to depend upon local circumstances and water quality, such as turbidity, etc. In making a decision the disadvantages of the sludge problem is becoming increasingly important when choosing the precipitation methods. Likewise, one must know the local conditions when making a choice between natural greensand zeolite and synthetic gel type zeolites—the first being tougher but less efficient and requiring more wash water. The greensand zeolite had the advantage of not being subject to damage by iron in solution and was less affected by waters of high or low pH value.

R. C. Bardwell, Superintendent, Water Supply, C. & O. Railway, Richmond, Virginia, in discussion, compared continuous softening processes with the older style intermittent (fill and draw) process. He said that upward flow settling tanks had proved economical of construction and in space required. Velocities (upward) of 8 ft./hr. or less allowed effective settling out of precipitates. He said that such waters as that of Norfolk (3 grains of incrustants per gal.) was once considered good but now industrial users remove even that little, with economy resulting. The C. & O. Railway softens Norfolk water through a zeolite bed and at Newport News caustic soda is used to soften the 6 grain water to one containing but 1 grain of hardness. Mr. Bardwell said that municipalities would frequently gain industrial consumers if softer water was provided. Staunton, for instance, had secured the C. & O. Railway as a new customer when that city replaced a hardwater supply with soft water.

W. F. Day, City Manager, Staunton, told of the satisfaction which had resulted from its soft water supply brought into the city through a 15 mile line. The new mountain water had been too soft and was corrosive until the addition of 70 lbs. of hydrated lime per m.g. at the intake had raised the pH of the water to 9.2 in the distribution system. Tests had indicated a complete checking of all corrosion.

Mr. Bardwell commented that a small amount of soda-ash had to be added to the Staunton water to prevent pitting of locomotive boiler tubes.

C. L. Crockett, Chemist, Norfolk and Western Railway, Roanoke, Va., reviewed practices of softening on the N. and W. Railway, it being standard in lime-soda softening to carry an excess caustic alkalinity of 35 p.p.m. and carbonate excess of twice that. Under these circumstances high degree sterilization resulted and a pH of 9.0 to 9.5 had appeared sufficient to destroy b. coli if sufficient contact time be allowed—below 50 deg. F. 4 to 5 hours and above 50 deg. F. 2 to 3 hours being necessary.

Prof. F. H. Fish, of the V.P.I. Chemical Department, Blacksburg, Va., added to the discussion by picturing the several reactions taking place when softening waters of varying characteristics and gave the weights of chemicals required in performing the several functions in softening.

[Digests of papers and discussions will be concluded in our next issue.]

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New York Sewage Works Association to Meet January 16th

As is customary, the meeting of the New York State Sewage Works Association will be held in New York City (Hotel McAlpin) on January 16th, the day prior to the beginning of the meeting of the A.S.C.E.

The program lists the following interesting papers to be presented:

(1) "Developments in Sewerage and Sewage Treatment"—H. P. Eddy, Sr.

(2) "Investigation of Pollution of the Hudson River"—Prof. Earl B. Phelps.
Discussion: W. W. Young; Richard Gould; Dr. Geo. Soper.

(3) "Digester Overflow Liquor—Its Character and Effect on Plant Operation"—Dr. A. J. Fischer.
Discussion: Glen B. Holmes; C. C. Agar.

(4) "Results from Six Months' Operation of a Chemical Precipitation Demonstration Plant at Chicago"—Major G. H. Gleason.
Discussion: Langdon Pearse; W. Donaldson; Alexander Potter.

(5) "The Results of Circulating Sludge vs. No Circulation in Separate Digestion Tanks"—C. E. Keefer.
Discussion: Dr. W. Rudolfs; Dr. A. J. Fischer.

(6) "The Why and How of Sewage Research in New York State"—Prof. Thorndike Saville.
Discussion: Prof. Earl B. Phelps; A. F. Dappert.

(7) "Selection and Utility of Porous Diffusor Plates and Holders"—A. B. Holmstrom.
Discussion: Frank C. Roe.

(8) "Present Aspects of Federal Aid to Sewerage"—Arthur S. Tuttle.

In the evening a joint dinner is scheduled to be held with the Sanitary Engineering Section of the A.S.C.E. at the Hotel McAlpin.

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The Status of P.W.A. Projects in Virginia

In the matter of getting water works and sewerage projects under way, as relief measures, Virginia has recently taken a lead position among the states. Based on comparisons of applications filed for P.W.A. assistance, per 100,000 population, Virginia stands very near the top of the list of states.

As of the middle of November, Virginia had 28 municipalities whose applications had been approved by the State Authorities and 6 were awaiting approval. Three municipalities had already been allocated funds by the P.W.A. to the amount of $2,950,000 out of a total of $5,896,303 applied for by the 34 municipalities. The largest allotment is for a sewerage system and sewage treatment works for Arlington County amounting to $2,500,000 and the second largest is for a cast iron pipe gravity water line for the city of Lynchburg, Va., amounting to $600,000. Both Virginia and Maryland have exceeded their quotas, tentatively set by the P.W.A. for each state in the Union, on the basis of population and other factors.

OHIO CONFERENCE ON SEWAGE TREATMENT

THE Seventh Annual Ohio Conference on Sewage Treatment was held at Findlay, O., on Oct. 19th and 20th immediately following the Thirteenth Ohio Conference on Water Purification.* Eighty-eight members and thirty guests registered for the Sewage Treatment Conference, making a total registration of 118 and attendance approximating 150.

F. H. Waring

Following the opening address by the Hon. H. O. Dorsey, Mayor of Findlay, F. H. Waring, Chief Engineer of the Ohio Department of Health, reviewed and summarized the marked progress made in Ohio with water works and sewerage projects under the P.W.A. program. Mr. Waring's review has already been covered in our November issue (p. 398)—the high light of which was the fact that 6 of his engineering staff had been engaged on nothing else of moment for the past 7 months than stimulating new water and sewage projects and assisting in expediting the actions. The applications on file had required 8 examining engineers in the P. W. A. State Engineer's office. At that date (Oct. 19th) 15 new sewage treatment plants at a cost of $11,500,000 were assured of construction in Ohio when approved by the P. W. A. and the same number of new sewerage systems plus additions and extensions in 29 more cities would require expenditures totaling an additional $18,000,000. Applications in prospect for additional P. W. A. loans and grants added to those now on file would bring the total for water works and sewerage installation or improvements to $60,000,000 on 273 projects—the largest of these being sewage treatment works and sewers.

Mr. Waring pointed out that the favored method of financing sewerage improvements was through issue of revenue bonds which could be issued without a vote of the people.

New Officers

The following officers were chosen for the year 1933-34:

Chairman: James R. Collier, Supt., Sewage Treatment, Elyria, Ohio.

Vice-Chairman: Walter S. O'Brien, Supt., Sewage Treatment, Lima, Ohio.

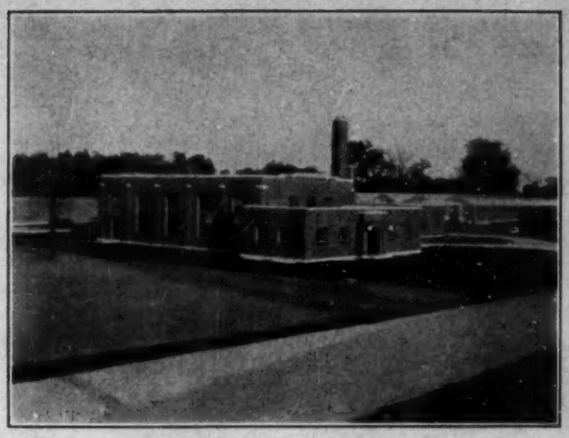
Secretary-Treasurer: F. W. Jones, Geo. B. Gascoigne, Engrs., Cleveland, Ohio.

Editor: Bruce M. McDill, State Department of Health, Columbus, Ohio.

Executive Committeeman: W. B. Lockhart,.Supt., Sewage Treatment, Fostoria, Ohio.

"Sewage Disposal as Practiced by German Cities"

One of the high lights of the Conference was the dinner address of C. B. Hoover, Superintendent of Water Works and Sewerage, Columbus, Ohio.



Findlay's New Sewage Treatment Plant

Mr. Hoover, having recently inspected the sewerage and sewage disposal facilities of eight of the most important cities in Germany, presented his impressions of German methods in a lucid and interesting manner. He said that the observation most impressive to his mind was the absence of nuisance along German streams receiving only partially purified sewage—particularly so when one realized the relatively low dilution ratio afforded by the streams. He had not found a single German stream black from sulphide production as we frequently find below American cities where dilution is as limited as that in Germany. He could only explain such conditions as probably being due to the lower water temperatures in German streams and pointed out that the latitude of central Germany was the same as that of northern Maine in this country. He also reminded his listeners that the German sewage is a stronger product than American sewage and that the average flow was but 40 to 50 gals. per capita.

Some of Mr. Hoover's observations of particular interest were the following:

At Berlin: The new Stahnsdorf activated sludge plant, constructed as a test plant, offered the greatest opportunity for experimental operation of any he had ever seen. The plant treats 35 m.g.d. sewage from 600,000 population. Sludge digester gas, treated to remove hydrogen sulphide and water, is used to operate gas engines; returned sludge is reaerated; excess sludge is returned to the crude sewage and the mixed sludge from the primary tanks is passed through thickening tanks and preheated to 126 degrees F. before discharge to digesters maintained at 70 degrees F. The crude sewage is preaerated and screenings are incinerated. Digested

T. C. Schaetzle, Retiring Chairman of the Conference

B. M. McDill, Editor of the Ohio Conference

*The 13th Ohio Conference on Water Purification was reported in our November issue.

Ohio Conference on Sewage Treatment, Findlay, O., October, 1933

sludge is dried on open sand beds of an area of 0.39 sq. ft. per capita.

For 75 years Berlin has been operating sewer farms 8 to 16 miles out of the city involving the requirement of one acre of sandy soil at rates of sewage application varying between 3,200 and 19,000 gals. per acre per day. Twelve separate sewer systems and 59 pumping stations are maintained. The Stahnsdorf plant will serve to determine future design of sewage treatment facilities for the city.

At Leipsig: Four treatment works serve the city. The main plant provides only sedimentation and chlorination (20 p.p.m. Cl.) is practiced to hold the small stream "sweet" for the 5 day period of flow (20 miles) to the Salle River, where dilution is ample. Chlorination also holds in check slime growths down stream. Sludge is removed from the settling tanks by Meider scrapers and is digested in lagoons 30 feet in depth.

The other smaller plants consist of Imhoff tanks and sprinkling filters and Imhoff tanks followed by activation. Considerable experimental work is under way at Leipsig to determine future treatment.

At Hanover: Plain settling tanks serve this city which must dispose of its sewage in a stream affording but 1 cu. ft. of flow per sec. per 1,000 population. Crude sludge is removed from the settling units every third day, treated with lime and dewatered by a centrifuge to produce a cake, of 65 per cent moisture content, used as fertilizer on nearby farm lands. Hanover is planning an activated sludge plant with sludge handling and disposal as at present except that the process will be continuous.

At Nurmburg: Two treatment works serve the city, providing sedimentation and separate sludge digestion. Here the dilution is limited to less than 1 cu. ft. per sec. per 1,000 population. At one plant the sludge is mechanically removed by a Meider scraper and heated digesters are employed. Digested sludge is dried on beds with floors of brick laid in sand with open joints, requiring only 10 or 11 days between sludge application and removal.

At Holley: Imhoff tanks and auxiliary separate heated digestion tanks serve the city. Only 0.4 cu. ft. sludge capacity per capita is required although the crude sewage contains 9 to 20 c.c. of settleable solids per liter and an average B.O.D. value of 400. The digester gas is scrubbed to remove impurities and used for power generation—excess over requirements being pumped 4 miles into city gas system.

At Stuttgart: The plant consists of clarifiers and 69 sprinkling filters with revolving distributors. The interesting observations was that the 5 foot depth filters produce results superior to those 7 feet deep. Why, was not explained.

The Ruhr District: In the Ruhr District, Dr. Imhoff, its Chief Engineer, has no simple problem. The dry weather flow of the streams frequently provide but 0.15 cu. ft. per sec. per 1,000 population and such circumstances had necessitated high degree of purification supplemented by artificial dilution which is provided by letting water down from storage lakes constructed for that purpose. Of the 15 plants serving the Ruhr District, four are activated sludge plants. The most interesting to Mr. Hoover was that at Relinghausen which

has Dorr Clarifiers and digestion tanks. The settled sewage is activated in units equipped with the Imhoff rotating paddles in combination with air diffusors. The power requirement had been but 7 h.p. per million gallons, notwithstanding the strong sewage treated. Digester gas yields of 0.7 cu. ft. per capita produced 1 h.p. from each 14 cu. ft. of gas used to operate the gas engines. The cost of treatment including amortization amounted to about 78 cents per capita per year and the effluent was being satisfactorily disposed of in a large lake.

Technical Sessions

T. C. Schaetzle presiding

"Operating Results and Costs at the Activated Sewage Treatment Plant at Lima, O."—WALTER S. O'BRIEN, Superintendent, Sewage Treatment, Lima, O.

W. S. O'Brien, Superintendent Sewage Treatment Works, Lima, O.

Jim Collier, Chairman-Elect of the Conference

Mr. O'Brien briefly described the Lima plant designed for 70,000 population to provide primary sedimentation, separate digestion and activation of settled sewage. The aeration tanks would provide 4.7 hours detention at designed capacity of 10 m.g.d.; digester capacity would be 0.5 cu. ft. per capita and glass covered sludge beds would provide 0.5 sq. ft. per capita. The plant was placed in operation in March, 1931.

At present the plant, designed for 10 m.g.d., treats 5.4 m.g.d. average flow and is operated as an activated sludge plant during summer, spring and fall and as a sedimentation plant in winter. Sludge from the clarifiers contains 8 to 10 per cent solids, during periods when excess activated sludge is not being returned to the crude sewage, and but 4 to 6.5 per cent solids during operation of the activation units. In sludge transfer to digesters short period pumping at frequent intervals had produced best results. Digested sludge contained 7 per cent solids; scum collecting under the digester roof had not been a problem. Supernatant liquors from the digesters when bled to the crude sewage had caused upset conditions in the aeration tanks. Digested sludge had required 20 day average drying period on glass covered beds.

Mr. O'Brien said that they had learned that in the aeration tanks it was possible to carry 4,000 p.p.m. suspended solids at Lima with improved results over the past practice of carrying 2,200 to 2,600 p.p.m. Air requirements had been 1.37 cu. ft. per gallon on the average; the B.O.D. values of crude sewage 149, settled 106, final 9 parts per million—all being averages. When bypassing the aeration units in winter, the primary and final settling tanks are operated in series to provide long period double sedimentation.

Operating personnel consisted of 3 operators, 3 assistants, one superintendent and an assistant. Operating costs had averaged $6.02 per m.g.d. when operating without aeration and with aeration the added power requirement (at 1 cent per k.w.h.) brought the average for the year to $12.34 per m.g. Operating costs are covered by sewer rentals at 80 cents per quarter up to 500 cu. ft. water consumption plus 15 cents for each additional 100 cu. ft. used. About 40 per cent of the total income had come from users paying the minimum charge and 35 per cent from large users and industrial plants—the remaining 25 per cent being delinquent.

JAMES R. COLLIER, Superintendent of Sewage Treatment, Elyria, O., said that he had found the chief problem of operation at Elyria to be that of "what to do with the supernatant digester liquor." Mr. O'Brien had found the use of the "sludge index" very helpful in operating aeration tanks but he had not at Elyria. Mr. Collier reported that corrosion tests applied to aluminum strips located at different points in the Elyria plant had indicated the metal to withstand attack by sewage and sludge gas very effectively. It looked to be a material deserving attention in sewage treatment plants.

R. P. VICKERS, Superintendent, Sewage Treatment, Salem, O., reported that the smaller activated sludge plant at Salem, with an electric rate of 1.6 cents per k.w.h., had cost $23.89 per m.g. to operate, of which $7.86 had been the average cost of power required per m.g. Supernatant liquor from digesters had to be disposed of on sand beds because of upsets experienced when added to the crude sewage. Air required had been 0.573 cu. ft. per gal., the aeration period averaging 5.3 hours.

H. D. WOODWORTH, Superintendent, Sewage Treatment, Madison, O., described the "Simplex" plant at Madison, designed for 1,000 people, which had consistently produced an effluent of less than 7.8 p.p.m. B.O.D. value. The two aerators provided a detention of 9.75 hours theoretically and the purification had cost only $29.00 per m.g. with current at 2 to 3 cents per k.w.h. With one cent power he presumed the cost would be in line with that at Lima.

C. K. CALVERT, Superintendent of Sewage Treatment,

G. A. Hall, Superintendent Sewage Treatment, Norwalk, O.

Geo. O. Behnke, Superintendent Sewage Treatment, Oberlin, O.

Indianapolis, Ind., was asked by the Chair to add to the discussion. He said cost comparisons were always difficult because of many variables to be considered. At Indianapolis, with power at 0.6 cents per k.w.h., the cost of treatment averaged $9.00 per m.g. and the total operating cost had been $13.00 per m.g. The lagooning of sludge had been responsible for a very low sludge handling cost. Adding $13.00 to cover interest, depreciation, etc., the total cost of treatment at Indianapolis had been $26.00 per m.g. He commented that efficiency of operation and consistent performance of the plant were to his mind more important elements than costs.

Mr. Calvert said that the time of sampling the stream below a sewage plant for evaluating results of treatment had been found to be an important consideration. The difference between conditions found at 2:30 p. m. and at 2:30 a. m. would surprise most of us—the night samples indicating much poorer stream conditions than the day samples.

A. H. Fretter, Superintendent Sewage Treatment, Medina, O.

B. H. Barton, Chief Operator Sewage Treatment Works, Findlay, O.

"Operating Features of Traveling Trickling Filter Distributors"—G. A. HALL, Superintendent, Sewage Treatment, Norwalk, O.

Mr. Hall's paper was, in this writer's opinion, one of the most carefully arranged papers it has been his pleasure to listen to. It was thorough and interesting, leaving little to be said further on the subject covered. It will serve as a reference article as well as one replete with timely information on various trickling filter distributors now available.

Having served as reliable devices for more than 30 years, Mr. Hall pointed to the recent trend toward increased use of the traveling distributor in America. The even distribution of sewage, low head required (12 to 18 inches), less odor production, flexibility and low cost of maintenance were characteristics in their favor. The three units at Norwalk had been satisfactory in every respect. Indicative of the serviceability of rotating distributors in America one could point to the eight Pontiac, Mich. units (110 ft. diam.) giving continuous service since 1916 at an average maintenance cost of only $4.50 per distributor per year. These mechanisms had operated efficiently regardless of the fact that they were in the open and temperatures of 20 degrees below zero were not uncommon. Other Northern installations had been at Portage, Wis., and Escanaba, Mich. Mr. Hall with the aid of lantern slides described the several styles of revolving distributors now in use and the special features of each. The largest unit ever built had been 212 ft. in diameter in which instance the revolving arms had been propelled by electric drive. The Adam's distributor of British manufacture was the oldest, whereas in America the Dorr Company and the Pacific Flush Tank Company units had more recently been developed as had a unit for rectangular filters by Link Belt Company.

GEORGE O. BEHNKE, Superintendent of Sewage Treatment, Oberlin, O., said that they had recently installed one of the Link Belt distributors on a rectangular unit 190 ft. long by 38 ft. wide with a stone bed depth of but 4 feet. The distributor trough traveled at the rate of 40 ft. per minute (10 minutes per round trip) and was driven by electric power. So far the operation had been wholly satisfactory.

Publicity to Sewage Treatment

At Akron moving pictures have been made of the operations of various units of the local sewage treatment works. These pictures, supplemented by others takens from an air ship, have been shown before various civic organizations in Akron to increase interest in sewerage and sewage treatment.

T. C. SCHAETZLE, Superintendent of Sewage Treatment at Akron, said that he felt that this publicity had been quite helpful and he had therefore brought along the pictures to show the Conference and would recommend such a scheme to the members for developing a better appreciation of the public in matters pertaining to sewage treatment. These interesting pictures were shown.

"An Improved Method of Clarifying Sprinkling Filter Effluents"—A. H. FRETTER, Superintendent, Sewage Treatment, Medina, O.

Mr. Fretter described a novel scheme of clarifying and further improving effluents from sprinkling filters which had been found superior to the operation of the slow sand filters as originally intended. The filters in part had been planted to grass by sodding the sand surface. Effluent from the final (humus) tanks flowing 60 feet across the grass beds (lengthwise) had come out at the far end brilliant and clear. Application at rates of 3 m.g.d. per acre of grass bed had been satisfactory and probably up to 5 m.g.d. would be permissible. At the inlet end profuse growths of algae had been observed but no troubles developed as long as the grass was not allowed to grow too high between cuttings with a hand scythe. When settleable solids in the humus tank effluent exceeded 2.5 c.c. per liter the grass roots became choked and the grass died. Some of the sand filters, operated in parallel with the grass filters, had given more trouble, greater nuisance and a higher cost of maintenance and operation than the new scheme. The cost of cleaning the sand units was $1.32 per m.g. as compared with maintenance of the grass units at 40 cents per m.g. applied.

C. D. MCGUIRE, Superintendent of Sewage Treatment, Columbus, O., cited an instance wherein a growth of cattails, through which effluent from sprinkling filters flowed, had removed 48 per cent of the suspended solids discharged. He thought that the physical appearance of effluents deserved more consideration than generally given. This, because of the public's evaluation of quality based on appearance and all notwithstanding the fact that requirements of health authorities were based on the actual quality rather than the apparent quality such as clarity and color. He thought that our standards for

Floyd Browne, Consultant in Sewage Treatment, Marion, O.

R. C. Sweeney, Engineer in Charge, Sewage and Sewage Disposal, Springfield, O.

effluents in the future might well include one defining physical appearance as well as chemical quality.

"The Findlay Sewage Treatment Plant"—B. H. BARTON, Chief Operator, Sewage Treatment Works, Findlay, O.

The Findlay plant, designed by H. P. Jones & Company, Consulting Engineers of Toledo, placed in operation in January, 1933, was described by Mr. Barton. Treatment consists of screening grit removal, incineration of screenings, sedimentation, separate sludge digestion and sludge drying on glass covered beds. Prechlorination is practiced during summer months.

From the city of 19,360 population, 80 per cent now being connected, the plant is treating an average flow of 2.4 m.g.d. The original design included activation units, the construction of which had to be postponed because of lack of funds. Grit is removed by a Dorr Detritor and the sludge from two Dorr Clarifiers is pumped to a Hardinge (heated) dome roofed digester having a capacity of 3 cu. ft. per capita for the 15,000 people connected. The digester had been equipped with special pressure release devices of interesting design to preclude explosion damage. The glass covers on the sludge beds were of Hitchen's design providing flexible ventilation. Digester sludge drawn to date had averaged 85.8 per cent moisture and dries readily. Odors from the plant had been observed in August when the point of chlorine application had been changed to provide prechlorination, with very satisfactory results.

The Findlay plant is operated by 3 operators and a part time superintendent. Operating funds are derived through sewer rental. The minimum monthly charge of 20 cents probably being the lowest in the country. Collections are made by the Water Department.

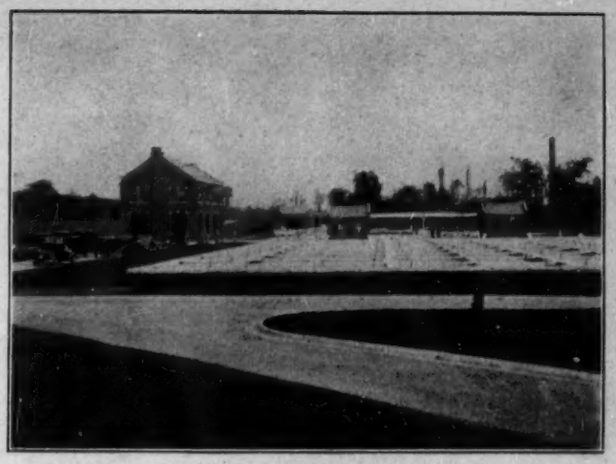
OTTO C. GOHLKE, City Engineer in Charge of Water Works and Sewerage, Findlay, O., said, that the new plant had been needed for some years because of the extremely bad river condition in and below the city. The bond issue to construct the plan had carried 3 to 1 because of such conditions and considerable relief was looked for even though the treatment was admittedly not as complete as originally planned. In commenting on financing by sewer rental, he was not sure that this was the most desirable scheme for the reason that the entire cost of billing and collection had to be borne by the Water Department. Further, the tendency of consumers was to reduce on water usage to reduce sewer rent as well as charges for water. In times such as these this economy of water use had further reduced the net return on water works operation and too much of the burden of financing sewerage was thereby directly and indirectly borne by the Water Department.

Round Table Questions and Answers

A unique scheme of balloting was used in arriving at the choice of topics for discussion during the Round Table Hour. The "Question Ballot" was marked by members present—those questions receiving the highest number of votes being put forward for discussion during the closing session of the Conference.

No. 1 Question: Concerned pre-chlorination vs. post-chlorination of sewage and the chairman called on L. H. Enslow of the Chlorine Institute to reply.

Mr. Enslow set forth the several reasons for the preference of pre-chlorination over post-chlorination where primary treatment and chlorination constituted the sole treatment given. Likewise the advantage of partial chlorination of crude sewages, as an odor control measure, regardless of the subsequent treatment given the sewage were enumerated. In partial pre-chlorination the chief object was that of reducing bacterial action with an aim to keeping the sewage as "fresh" as it would



Sewage Treatment Plant at Lima, O.

ordinarily be in cold weather. Odors are not produced in cool weather, because biological activity in the sewers and settling units is then subdued by the lower temperature—chlorination had the same effect.

In connection with settling only it was preferable to employ pre-chlorination rather than post-chlorination for the reason that the settling unit served as a reservoir to balance off fluctuations in quality and quantity of sewage and supplied long contact periods at no extra cost for chlorinating contact chambers otherwise needed. The efficiency of the settling units were usually increased by pre-chlorination—especially in warm weather—and sludge digestion was apparently improved rather than hindered. The proof that pre-chlorination was preferable seemed to be amply borne out in practice. In chlorinating sprinkling filter effluents the application should preferably be made at the inlet end of the humus tanks—again it was a case of "pre-chlorination" in post-chlorination practice.

H. C. GROWDEN of Portsmouth, O., said that the Portsmouth (Sciotoville) plant, which he had supervision over, had been pre-chlorinating since 1926 with good effect ahead of the Imhoff tank. They had done so in preference to the former practice of post-chlorination because odor control had been an important result procured and disinfection efficiency was kept on an even keel. Neighbors adjacent to the plant had ceased to complain of odors. He believed that the Portsmouth plant was among the first to adopt consistent pre-chlorination and had been carefully watched because the effluent discharged above the water works intake.

W. B. LOCKHART, of Fostoria, O., spoke of the improved stream condition below the Fostoria plant which had resulted from chlorination to an extent that the plant effluent carried residual chlorine at all times.

Question No. 2: "Is it Feasible to Attempt to Market Sludge?" The chairman called on M. W. Tatlock, Superintendent of Sewage Treatment at Dayton, O., to reply.

Mr. Tatlock said that the answer so far as Dayton was concerned could be found in the fact that it was being done there on a paying basis. Having sold the entire Dayton sludge output last summer, it was necessary to fill an excess demand by hauling 120 tons of sludge from the Indianapolis plant. In all, 1,369 tons of dried ground digested sludge from Imhoff tanks had been marked by them during the past 10 months—the gross income being $9,500 for the production. At least 45 per cent of this could be claimed as a net profit. The price for the material, in 100 lb. bags, was $10.00 per ton. Orders for 25 tons or over were sold at $6.00 per ton. Small orders went for $1.00 per hundred pounds.

IMPROVING SETTLING TANK EFFICIENCIES AND LOWERING OPERATING COSTS AT AURORA, ILL.

By WALTER A. SPERRY

Superintendent, Aurora Sanitary District, Aurora, Ill.

Walter A. Sperry

THE Aurora, Illinois, Sanitary District plant, designed jointly by the firm of Alvord, Burdick & Howson, Consulting Engineers, and Walter E. Deuchler, Engineer for the District, was placed in operation in September, 1929. It is of the separate sludge digestion type and trickling filters provide secondary treatment. Fine screens, grit removal, settling tank and digestion tank apparatus are of the Dorr Co. type.

Planned ultimately to serve 67,000 people, the plant now serves 47,000 with an average flow of 7.2 m.g.d. The filter effluent is discharged without secondary settling to the Fox River. The average annual flow of the river is 800 c.f.s. during the summer and fall months when filter operation is required. During the winter and spring months, however, advantage is taken of the large volume of flow in the river and filter operation is suspended. The ability to give the sewage primary treatment, without pumping, results in a substantial saving in power costs during suspended secondary treatment.

The four settling tanks or clarifiers are each 50 feet square and 10 feet deep. They are equipped with grease skimming apparatus and traction type clarifier mechanism. They are supplied with inlet and outlet channels equipped with weirs and are fed from an influent channel running the length of the four tanks. Shear gates control the flow through each tank.

Until April, 1932, the removal of suspended solids by these tanks averaged but roughly 40 per cent as compared with an average expectancy of 60 per cent. Mr. L. R. Howson, a member of the above firm of designing engineers, suggested that these low results might be due to the travel of the revolving clarifier mechanisms which rotated once every 22 minutes, at a speed of about 4 feet per minute. Suspended solids studies on these tanks with the mechanism running and idle, however, indicated the probability that inefficient distribution of flows to and through the tanks to be the cause of the low efficiencies observed.

Current flow-meter tests in the inlet channels of the tanks, checked against the total flow, indicated the following erratic distribution of flow to the tanks:

Flow to Clarifier Tank No. 1 = 23 per cent
Flow to Clarifier Tank No. 2 = 33 per cent
Flow to Clarifier Tank No. 3 = 27 per cent
Flow to Clarifier Tank No. 4 = 17 per cent

Upon checking the setting of the inlet and outlet weirs with a surveyor's level these were found to be considerably out of line. Originally the outlet weirs were set level. The inlet weirs had a drop of 1 inch between entrance end and the far end of the inlet trough, to compensate for decreasing velocity. On resetting, both the inlet and outlet weir plates were set level and checked within an eighth of an inch.

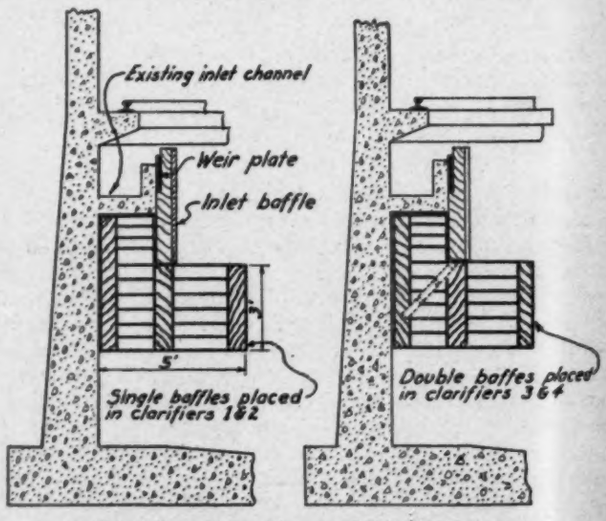
Under this new condition, with the influent shear gates wide open and during flows ranging from 6.5 to 9.5 m.g.d., the distribution of sewage to each tank was within a variation of but 2.5 per cent from the theoretical 25 per cent desired. Thus the external distribution defect had been corrected.

Suspended solids studies on the tanks before the above weir changes were made showed the suspendid solids entering the tanks to range from 33 per cent above to 27 per cent below the average for the four tanks.

A second series of suspended solids tests for evenness of outflow across the outlet weirs showed a heavier discharge from the center to the far side of the weir than over the near side. This indicated "short circuiting" which was subsequently checked by dye and salt tests. Fluorescine dye would be carried repeatedly across the side of the tank furthest from the inlet end of the influent channel in ten minutes while none would appear across the near half of the outlet weir. This "internal" tendency of the tank to short circuit was caused by a strong cross current set up under the inlet trough, such being induced by the high velocity of the inflowing sewage and was exceedingly marked.

Influent Baffling Resorted To

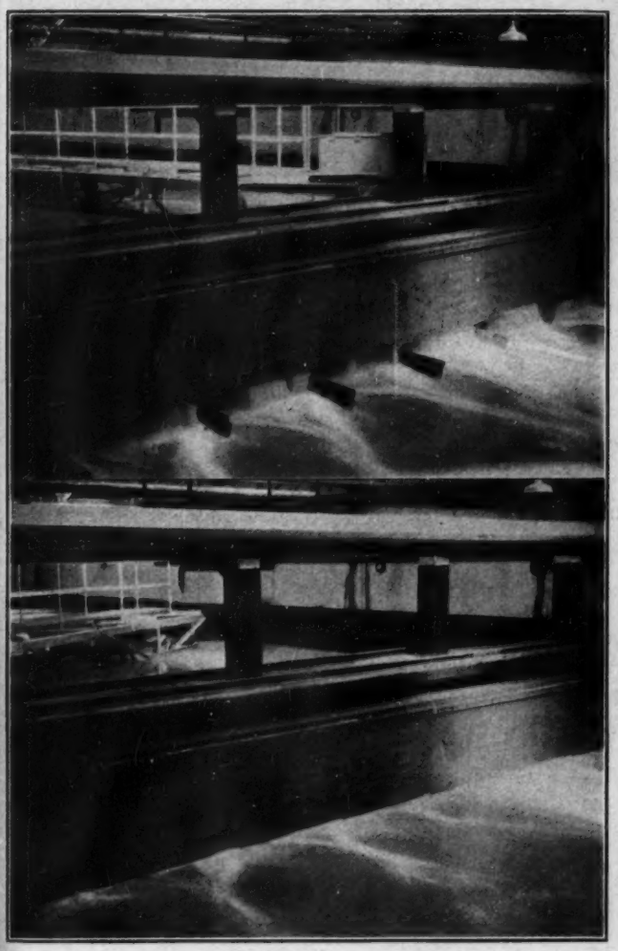
After cooperative planning with Mr. Deuchler and Mr. Thompson of the Engineering Department a series of vertical baffles were placed at right angles to the inlet channel, butting against the inlet wall of the tank, beneath the inlet channel and behind the existing inlet



7 baffles placed in each clarifier spaced 5 feet apart. Baffles built of hard wood-soaked with creosote oil and secured to the existing inlet baffle supports.

Detail Sketch Showing Baffles Installed in Sewage Clarifiers at Aurora, Ill.

baffle. (See illustrations.) These were spaced 5 feet apart and extended out into the tank as far as permissible without interfering with the travel of the rotating clarifier bridge. The effect of these cross baffles was to stop the sidewise currents set up behind the inlet baffle and beneath the inlet channel and directed the flow uniformly



Effect of Baffling Clarifier Influent

The two pictures above are of interest in indicating clearly the tendency of the inlet velocity to set up a current beneath the inlet channel. Flow in channel is from left to right. Note tendency of water (upper picture) to pile up on the left side of each baffle, and the effect of the baffle in directing this current across the tank to the outlet side. The lower picture was taken after the baffles were submerged a few inches. Note the current-making tendency of the incoming sewage as indicated by the "boiling" water above each baffle.

across the tank towards the outlet side. These so-called "plain" baffles were constructed in tanks No. 3 and No. 4.

In tanks No. 1 and No. 2 the baffles were modified to a double type by the addition of a series of boards to box in the space beneath the inlet channel and the wall of the tank. Openings (cracks) were left between the boards for the escape of the inflowing sewage. (See illustration.) Their effect was to kill all disturbing currents behind the baffle before release to the tank. Subsequent tests, however, as to the effectiveness of this modification showed no appreciable advantage over the "plain" baffles in tanks No. 3 and No. 4.

Results

After the correction of the weirs and the addition of the baffles, tests covered in Table 1 indicated the more even discharge obtained.

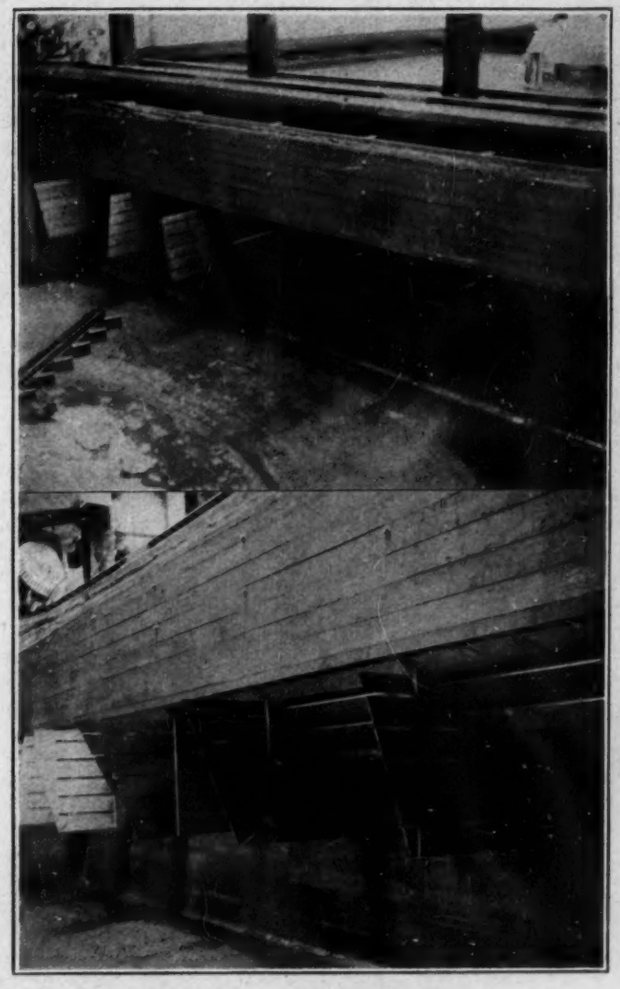
These figures indicate a variation of from 5.8 per cent above to 3.8 per cent below the average as compared with the much less satisfactory conditions previously commented upon as existing before baffling.

TABLE I

	Clarifier No. 2 (Single Baffles) Suspended Solids Delivered at Outlet Weir, P.P.M.				Clarifier No. 3 (Double Baffles) Suspended Solids Delivered at Outlet Weir, P.P.M.			
	West	Center	East	Average	West	Center	East	Average
	34	10	53	32	16	49	16	27
	49	51	86	62	91	67	52	70
	54	58	62	58	55	56	63	58
	42	37	53	44	56	59	49	55
	49	61	59	56	54	56	67	59
	47	33	31	37	43	44	50	45
Av'ge..	49	42	57	48	52	55	50	52

After these changes had been completed in all tanks studies were made during the remainder of the year to compare the performance of tanks No. 3 and No. 4 with "plain" baffles with that of tanks No. 1 and No. 2 with the double baffles. During this period Dr. Fisher of the Dorr Co. suggested the following method of determining the "efficiency" of the system, which procedure was followed.

For each test, a sample of the crude sewage was collected in a bucket of approximately the surface and depth ratios as that of the tanks. The suspended solids were run immediately and again at the end of a period equal to about 80 per cent of the theoretical time of detention



The Two Styles of Baffling

Upper view: Showing the shape and placement of "Plain" baffles which proved most practical. Lower view: Shows the secondary slotted baffle between the plain baffle and referred to as double baffling in the test. This baffle was very effective but not so practical because the openings tended to clog eventually. It was discarded.

(calculated for the flow of the time of test) taking the sample from very near the surface in the bucket. At the same time suspended solids were run from the discharging side of the tanks under test. The per cent removal in the bucket divided into the per cent removal by the tank being called the "efficiency" rating.

Table II reveals the results of a series of tests comparing the operation of tanks 1 and 2 with the double baffles with tanks 3 and 4 having single baffles.

TABLE II

(Double Baffles)

	No. of Tests	Raw Sus. Sol.	Lab. Eff. †	No. 1 % Red.	Eff. †	% Red.	% Eff. *	No. 2 Eff. †	% Red.	% Eff. *
Light Flows: (Clarifier mech. operating)	5	132	42	68.1	46	65.3	96.0	43	67.4	99.1
Heavy Flows: (Clarifier mech. operating)	8	306	60	80.5	74	75.8	94.3	61	80.1	99.5
(Clarifier mech. idle)	4	150	52	65.0	55	63.3	98.1	49	67.1	100.0

(Single Baffles)

	No. of Tests	Raw Sus. Sol.	Lab. Eff. †	No. 3 % Red.	Eff. †	% Red.	% Eff. *	No. 4 Eff. †	% Red.	% Eff. *
Light Flows: (Clarifier mech. operating)	6	146	46	68.5	52	64.4	93.9	53	63.7	93.0
Heavy Flows: (Clarifier mech. operating)	7	286	57	80.0	67	76.2	95.2	63	78.0	97.5
(Clarifier mech. idle)	5	231	54	76.5	67	71.0	92.8	56	75.6	98.8

† = suspended solids in effluent.

* = Per cent efficiency or "efficiency rating" as defined by Dr. Fisher.

Summary of results derived from the laboratory studies and changes made to the clarifiers:

(a) No particular advantage was gained by the double baffles. They were removed after a tendency to clog developed, despite the wide spaces provided between the boards.

(b) A speed of approximately 4 feet per second for the clarifier does not interfere with effectiveness of settling mechanism.

(c) The settling tanks used at this plant perform efficiently when the conditions of flow to and through the tanks are properly controlled.

(d) For the 15 month period from January 1, 1931, to April 1, 1932, the following average results were obtained:

Suspended solids removal	39.4 per cent
Pounds of solids removed to digestors daily	3,150
Cubic feet of gas produced per day	27,420

For the nine months' period between April 1, 1932, and January 1, 1933, the following average results were obtained (baffles in place):

Suspended solids removal	60.3 per cent
Pounds of solids removed to digestors daily	4,410
Cubic feet of gas produced per day	36,700
Increased solids removal from effluent to the river	37.2 per cent

(e) Due to the increased effectiveness of the tanks the number in use during the "off" filter season has been reduced from 4 to 2 saving the maintenance care and current required to operate two tanks.

Year	1931	1932	1933
Tanks in use	4	4	2
Average removal of suspended solids January to April, inclusive	36.0%	45.5%	42.3%

(f) Electric bills for the first five months of 1933 show a saving of about $25.00 per month during the winter season, due to reduction of clarifiers required in service from four to two.

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Steps Taken at Buffalo Conference To End Niagara River Pollution

The problem of ending the pollution of Niagara river from the discharge of untreated sewage into the river by the cities of Buffalo, Tonawanda, North Tonawanda and Niagara Falls, and the resulting menace to public water supplies derived from this stream was the subject of discussion by local civic and health officials at a conference called by Thomas Parran, Jr., M.D., state commissioner of health, at Buffalo, Nov. 22.

According to *Health News,* a publication of the New York State Department of Health, three proposed solutions were considered:

1. The Gascoigne plan providing for revamping the internal sewer system of the city of Buffalo and for the interception and treatment of the sewage of the city.

2. The Lupfer plan providing in substance for the formation by legislative enactment of a Niagara-Metropolitan Sewerage District comprising a considerable part of the western sections of Erie and Nigara counties.

3. The Young plan providing for the treatment of the sewage of Buffalo, Tonawanda, North Tonawanda and Niagara Falls at four separate plants, and the extension of the intakes of the water supplies.

The metropolitan commission plans call for fairly complete treatment of sewage leaving the intakes at their existing points while the Young plan provides for less complete treatment of the sewage and for extending the water intakes to points beyond the influence of sewage from the cities involved. The conference agreed that a detailed study should be made of both proposals for the purpose of determining which is more desirable and economical.

Referring to the Young plan, Doctor Parran said:

Under this plan the proposed intakes would be beyond the influence of the sewage pollution from Buffalo, Tonawanda, North Tonawanda and Niagara Falls and assure protection of all of the water supplies derived from the Niagara River.

With the public water supply intakes extended as proposed, and no communities furnished with water derived from the polluted sections of Niagara River, a much cheaper and lower degree of treatment of the sewage from these municipalities would be permitted.

Even though very complete treatment of the sewage were provided for the sewage tributary to the Niagara River, such treatment would not afford complete protection to the water supplies derived from the present intakes, inasmuch as it would be economically impracticable to provide for the interception and treatment of more than from two to two and one-half times the dry weather flow of sewage, so that most storms would result in the overflowing of combined sewage in the river and create a menace to the water supplies.

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S. I. Zack Joins Filtration Equipment Corporation

Mr. S. I. Zack, Assoc. M. Am. Soc. C. E., who was for ten years in the Engineering Department of the Sanitary District of Chicago and recently Associate Editor of WATER WORKS AND SEWERAGE, is now engaged as Sanitary Engineer, on sewage and industrial waste disposal problems, by the Filtration Equipment Corporation, 350 Madison Avenue, New York, N. Y., subsidiary of the American Cyanamid Company.

MEETING NORTH CAROLINA SECTION A. W. W. A. AND NORTH CAROLINA SEWAGE WORKS ASSOCIATION

Harry L. Shaner, President-Elect

THE North Carolina Section of the American Water Works Association and the North Carolina Sewage Works Association held their annual convention in Statesville, N. C., November 13, 14 and 15, 1933. Registration was upwards of 185, with an attendance of 200 or more.

A feature of the Convention was the discussion of "The Federal Works Program" following the banquet and the "Symposium on Federal Works Program" which occupied the closing forenoon session. For these important features Professor H. G. Baity, Secretary of the Association, and North Carolina's State Engineer for the P. W. A., had on hand the Hon. Geo. L. Radcliffe, Regional P. W. A. Advisor of Baltimore, Md.; Frank Page, of Raleigh, N. C., Chairman of the State Advisory Board; Chas. M. Johnson, Chairman of the Local Government Commission; S. H. Wright, Engineering Examiner of the P. W. A. Office; W. H. Booker, Chief Engineer of the State Department of Health, and other important officials.

The Symposium was open to questions from the floor and many engineers and municipal officials attended for the purpose of asking questions. Such free discussion was fruitful in clarifying many questions of importance to everyone interested in securing local benefits through Federal Public Works Administration channels.

The keynote of the talks by Mr. Page was the fact that city officials had been paying too much attention to recalcitrant taxpayers. Consequently they had let the city suffer from neglect of its capital investments in utility properties and other public properties. Neglect in the matter of proper replacements and maintenance had gone much too far and it had been false economy to allow this situation to continue. Mr. Page made a clean cut analysis of the value of the P. W. A. dollar, borrowed now for repayment over a period of years, in which he showed that the P. W. A. dollar would cost but $1.06 whereas the banker's dollar had been costing the same cities, now afraid to borrow Federal monies, exactly $1.78. He said that applications for loans for Water Works and Sewerage projects in North Carolina totaled but $1,600,000. It was evident that the cities of the state would pay their share of the bill for Federal funds loaned cities in other states and, unless acting more promptly, would be the losers thereby. He said that it was encouraging, however, to observe the impetus gained recently in the matter of city planning for betterments under the advantageous terms offered by the Federal Government.

The labor rate of 45 cents per hour sounded high in the South, but actually under P. W. A. financing it cost the municipality only 26 cents per hour, whereas, labor at 30 cents per hour, paid for with bond money costing 6 per cent over a 25 year period, amounted to 53 cents per hour—just about twice the net labor cost when paying the 45 cents required under P. W. A. rulings. That was the true picture of the situation which had needlessly caused so much confusion and misapprehension in the South and Southeast and reluctance to apply for P. W. A. funds.

Mr. Radcliffe added: that test cases, in which contractors' bids had been submitted on labor costs under P. W. A. regulation and under ordinary procedure, had proven the fallaciousness of the argument that P. W. A. labor rates added to the net cost of projects—in fact some cases proved the opposite.

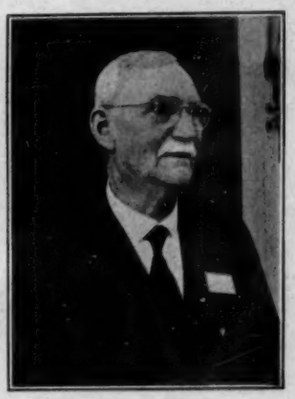
The Symposium on the Federal Public Works Program did much to clarify impressions of North Carolina's municipal officials and served an excellent purpose by being conducted as an open forum. Mr. Baity is to be complimented on the arrangement.

Testimonial Dinner to an Old-Timer

Another distinctive feature of the Convention was the testimonial dinner, given by the city of Statesville, to honor its retiring Superintendent of Water Works, J. D. Cochran, who had completed 44 years of active service in the Water Department of Statesville.

Following a speech of praise, the Hon. E. R. Rankin, Mayor, presented a silver pitcher to Mr. Cochran as a testimonial of esteem by the city administration. Members taking part in paying tribute to Mr. Cochran were President J. H. Bridgers, W. E. Vest of Charlotte, Captain Mickie of Durham—all Superintendents; W. H. Booker and H. G. Baity.

J. H. Bridgers, Retiring President



J. D. Cochran, Superintendent Water Works, Statesville, N. C.; Retires After 44 Years of Active Service

At the close of the dinner another "old timer," Ernest Bane, who had served the city of Raleigh as Superintendent of Water Works for 40 years, but prevented from attending the meeting because of illness, was sent a telegram of well wishes from the Association.

New Officers and Business

Elections returned the following new officers:

President: Harry L. Shaner, Winston Salem, N. C.
Vice-President: P. W. Frisk, Enka, N. C.
Secretary-Treasurer: H. G. Baity, Chapel Hill, N. C.
Director A.W.W.A.: M. F. Trice, Raleigh, N. C.

A. O. True was returned as Chairman of the Nominating Committee and J. S. Whitener was named as Representative on the Board of the Sewage Works Federation. W. E. Vest continues as Editor of the Journal of the N. C. Section, a duty which he took over upon death of Earle McConnell of Charlotte, former Editor and valued member of the Association.

The 1934 Convention will be held in Elizabeth City, N. C.—that municipality having made a strong bid for the vote given it by the members assembled.

Report of Committee on Statistics—W. H. Booker, Chairman.

The report revealed, that replies to the annual questionnaire sent to North Carolina municipalities had indicated that 19 cities contemplated or had under way improvements to water works or sewerage. Fifteen expected to finance through P.W.A. assistance and 4 out of current revenues. The largest expenditure for sewerage would be that for Durham, amounting to an estimated $700,000 for sewers and sewage treatment works, on which bids had already been received.

Water rates had been increased in two municipalities whereas three had decreased rates during the year. Unfortunately, 7 replies indicated decreases in salaries of water works employees whereas only 2 reported increases. Seven replies indicated a further decrease in water consumption—none an increase.

Report of Committee on Sewerage Financing—W. M. Piatt, Chairman.

The report presented in the absence of the chairman called attention to the passage of 3 new legislative acts during the year which made it permissible to combine the Water Works and Sewerage Departments of municipalities in North Carolina for the purpose of financing sewerage betterments and placing sewerage on a self-supporting basis.

"Association Affairs" was the topic of a brief talk made by Beekman C. Little, Secretary of the A.W.W.A. Mr. Little reviewed the important work of the Association's Committee on National Recovery and Water Works Construction and the work of President Malcolm Pirnie, whose duties with the N.R.A. in Washington prevented him from attending this meeting. He reported that the clouds were lifting rapidly in the water works field and that the 1934 Convention in New York at the Hotel Commodore was expected to be a large one with 10,000 sq. ft. of floor space allotted for manufacturers' exhibits. The Association had pruned its expenses to keep within the reduced budget and was operating within its present annual income, no "red ink" having been allowed to show on the Association books at any time. He said, that the complete index for the Journal of the A.W.W.A. during its 50 years of existence was about to be completed and prepared for distribution by Mr. Ruggles, Assistant Secretary of the Association.

Mr. Little reported that the newest Section of the A.W.W.A. would probably be announced within the week. He was referring to the Virginia Water and Sewage Works Association which voted on November 16th to become the Virginia Section of the A.W.W.A., as reported elsewhere in this issue.

Award of Maffit Membership Cup

The Maffitt Cup, awarded each year to that member bringing the greatest number of new members into the Association, was won by M. F. Trice, Assistant Engineer of the North Carolina Department of Health, and newly elected Director of the A.W.W.A. The donor of the cup is McKean Maffitt, Superintendent of Water Works, Wilmington, N. C. Competition to win the award has been highly effective in building up the membership of the N. C. Section.

Entertainment followed the Testimonial Dinner to Mr. Cochran, and following the Annual Banquet there was a dance. There was the customary golf tournament and the Convention closed with an old-fashioned Barbecue given by the Statesville Water Department on the afternoon of November 15th.

Technical Sessions

(Pres. J. H. Bridgers presiding)

A Symposium on Water Sources

"Relation of Geology to Ground Water Resources of North Carolina"—H. J. Bryson, State Geologist, Chapel Hill, N. C.

Mr. Bryson pointed out the increasing attention being given wells as sources of public water supply in North Carolina in recent years, due in part to the effect of drought years on small stream yields and, further, because of the increasing pollution of streams. He discussed the three major geological belts of the State and the expected quantities and qualities of water which each might yield from drilled wells, depths of the important water strata, etc. In the mountain area the ground water was of good quality and abundant in yield. Gravel packed wells in the coastal plain (200 to 300 ft. depth) would yield 500 gals. per min. on the average, but depending on large yields from the Piedmont (central) portion of the state was hazardous. He stressed the importance of having geological information or advice before locating wells and illustrated his point by citing cases to show how money had been wasted by drilling in faulty or questionable locations.

W. E. Vest, Superintendent Water Works, Charlotte, N. C. (Editor of the North Carolina Water Works Journal)

L. I. Lassiter, Superintendent Filtration, Wilmington, N. C., Retiring Vice-President

Editor's Note.—It is increasingly evident that well drilling and ground water supply development is hazardous and frequently wasteful unless the project is carried forward in a scientific manner, with the advice of geologists and the development conducted by thoroughly experienced operators and drillers.

"The Crisis in Stream Gaging in North Carolina"—H. D. Patton, Chief Engineer, N. C. Department of Conservation, Chapel Hill, N. C.

Mr. Patton recounted the great need of continuous stream flow data for use by engineers and others interested in developing industrial or domestic water supply. The continued operation of stream gaging stations established in recent years in North Carolina, he said, was

seriously threatened by cuts in Federal and State appropriations, reducing the $20,000 annual fund to $8,000. Stream flow records at 38 of the stations would become of little or no value unless the 6 year records to date could be extended at least another 4 years to provide the minimum dependable record covering a 10 year period. It was usually conceded that a truly representative record should cover a 30 year period, there being pitifully few of these. In fact, only 15 of the 68 stations

M. F. Trice, State Department of Health, Raleigh, N. C., Director of the Association; Winner of the Moffitt Cup

N. D. Doane, Chemical Engineer, Permutit Co., Charlotte, N. C.

established in North Carolina have records covering 10 years and longer.

He appealed to the Association for its support and assistance in procuring a return of State appropriations to that of recent years, in order that the records might become of real value. For the present they were carrying on with P.W.A. assistance and the real crisis would come when these funds were exhausted.

"Why Continuous Stream Gaging?"—E. D. BURCHARD, District Engineer, U. S. Geological Survey, Ashville, N. C.

Mr. Burchard amplified the statements made by Mr. Patton, saying that the work under his supervision had suffered but no stations would have to be completely closed until January 1, 1935, when P.W.A. funds would be exhausted. He stressed the importance of records to satisfy industrialists, seeking locations for plants, that available sources of water supply were dependable. In this, states providing basic long period records of stream flow would have the edge on those with imperfect records.

H. G. Baity laid emphasis on the fact that some of the most important streams had gaging stations which had been established but a few years and the closing of these would be a serious loss in that 6 years of records would become almost valueless.

"The Investigation of Ground Water in the Elizabeth City (N. C.) Area"—S. W. LOHMAN, Engineer, U. S. Geological Survey, Washington, D. C.

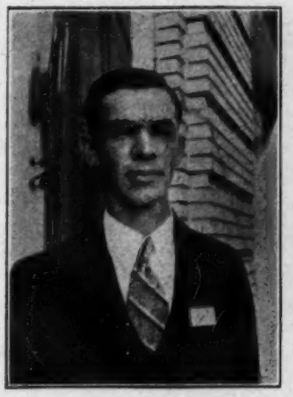
Because of inferior quality of the surface water supply now being taken from the Dismal Swamp drainage area for municipal use by Elizabeth City, N. C., the possibility of developing a new supply from wells had been investigated by the city with the assistance of the U. S. Geological Survey and State Agencies. The result had been the location of a satisfactory shallow water strata and the decision to develop shallow well fields rather than deep wells.

Mr. Lohman's paper disclosed the thoroughness with which all possible areas, types of wells and specific locations had been investigated and studied. The investigations constituted a truly scientific and painstaking bit of work which was related by the author clearly and concisely. Their first attempt had been on a deep test well which had been put down to a depth of 450 ft. at a location near the existing filtration plant. The quality of water yielded was not satisfactory and the volume insufficient. Even from the higher strata the solids content of the water was 950 p.p.m., of which 300 p.p.m. was hardness. The lower water contained 3,200 p.p.m. chlorides.

Turning to the possibility of shallow (driven) wells, a more extensive study had been made and many test wells of 1.25 inch diameter put down to between 25 and 30 ft. depths over a wide area. To determine rates of yield from the area finally selected as the most promising, a 9 inch cased well with gravel wall had been put down 30 ft. to the water bearing sands for continuous pumping. The yield had been 2 gals. per min. per ft. of draw down but the permeability of the sands proved disappointing, being but 250 on the scale.

From the data procured it had been decided to develop the shallow strata (25 to 30 ft.) by establishing batteries of small diameter driven point wells at selected points with pumping stations at each. The expected economical and dependable yield being 10 gals. per minute, several batteries of 10 wells each were planned to provide the 450 gals. per min. required by the city. Because of the shell formation the water would contain 165 p.p.m. of carbonate hardness and 8 p.p.m. of ferrous iron. The chloride content was but 15 p.p.m. as compared to 3,200 p.p.m. in water from the 450 ft. well and lesser amounts in strata tested below the 40 ft. level. The water from the well fields would be delivered to the existing filtration plant where aeration, softening and filtration would remove the iron completely and hardness to the required degree.

A. P. MILLER, U. S. Public Health Service, complimented the author and those in charge of the investigations, the results of which had indicated the value of scientific attack of a problem which was far from being simple. The economic significance of such procedures



Jas. M. Potter, Superintendent Water Purification, Hertford, N. C.

R. W. Luther, Superintendent Filtration, Elizabeth City, N. C. (5,000 *Parts of Salt and Dead Fish in His Water Supply and He Can Still Smile*)

deserved more recognition as being of primary importance to municipalities.

L. H. ENSLOW said that he had had experience with water of similar quality in the area contiguous to Norfolk, Va., the treatment of which had not been difficult. He wondered if the modernized scheme of developing infiltration galleries—so-called "water-mining"—had been given consideration in these investigations. The "water-mine" was constructed by driving in well points horizontally at any desired depths either from an

Meeting of North Carolina Section A. W. W. A., and North Carolina Sewage Works Association

infiltration gallery or radially from a large diameter well, the water flowing into the gallery or well by gravity.

Mr. Lohman, judging from his reply, apparently understood that the question referred to old style infiltration galleries instead of what is equivalent to a well battery feeding into a conduit or a large diameter circular well serving as a collection reservoir.

"Some Notes on Softening Ground Water with Hydrated Lime"—JAS. M. POTTER, Superintendent of Water Purification, Hertford, N. C.

At Hertford, the filtered water supply from the river had given trouble due to its salt content, paralleling somewhat the experiences at Elizabeth City: corrosion of mains had been serious and necessity of flushing frequent. As a result, driven wells had been put down and now one half the water consumed is taken from these wells and mixed with the river water. The well water having a hardness of 206 p.p.m.; free CO_2 of 30 p.p.m. and iron content of 2.9 p.p.m.; created other difficulties requiring conversion of the filtration plant into a softening plant. The treated water is being delivered with hardness content of 60 p.p.m. and iron content of 0.07 p.p.m. at a cost of $9.50 per m.g., hydrated lime being used as the softening agent.

In controlling chemical feed he had checked calculated dosages, based on chemical analyses, against dosages indicated by jar tests in the laboratory on several occasions. The two methods checked within 5 per cent of each other. Since the new scheme had been started corrosion had been reduced by at least 70 per cent in the mains, the water had been rendered satisfactory for ice manufacture and complaints of taste had ceased. They had estimated the saving in soap consumption at $1,600 per year as the result of softening.

E. P. MERIDITH, Superintendent of Water Works, Washington, N. C., reported a similar experience wherein the city had converted its filtration plant to a softening plant after having put down a well. Reducing the hardness to 47 p.p.m. from 160 p.p.m. had required 6 g.p.g. of hydrated lime and they had found softening less expensive than ordinary coagulation of the surface supply used prior to the well development.

"The Latest Developments in Water Softening by Zeolites"—N. D. DOANE, Chemical Engineer, The Permutit Company, Charlotte, N. C.

Mr. Doane reviewed recent developments in modern water softening wherein zeolitic softening is being used in conjunction with lime-soda softening or as the single process. He illustrated his talk with lantern slides of representative municipal plants utilizing zeolitic softening, most of which had been of recent construction. Zeolitic softening had been of high importance to industrial plants for years and particularly to textile manufacturers who required a water with practically zero hardness in various proportions with unsoftened water.

The resistance of zeolite grains against wear and disintegration had been improved materially in recent years by processing. In ordinary practice Glauconite (a green sand zeolite) would lose only 2 to 3 per cent per year by wear. Iron and manganese removal by zeolite was also assured, without deleterious effect, along with softening. The capacity of modern Glauconite was as great for magnesium as for calcium and the salt requirement could now be guaranteed at 1 pound for each 2,000 grains of hardness removed.

Mr. Doane then described the 100 per cent automatic zeolite softening equipment recently developed by the Permutit Co. The equipment could readily be added to existing plants and would pay for itself in salt and labor savings. Further, the human element would not have to be depended upon and the mill, factory or city would be assured of continuous uniformity of softening performance. The operation of the automatic softening device was described by Mr. Doane with the aid of lantern slides.

In the discussion following, it was stated by Mr. Doane that sodium salts could be removed by special magnesium zeolites, the process being just the reverse from softening, i.e., magnesium chloride or sulphate being used in the regeneration process.

"Unusual Experiences with Swamp Water at Elizabeth City, N. C."—R. W. LUTHER, Superintendent of Filtration, Elizabeth City, N. C.

Mr. Luther reviewed some of the difficulties met with in purification of water taken from the Dismal Swamp are for use by Elizabeth City. Backing up to the tidal dam, salt water would at times find its way under or around the ends of the structure. The result: a highly colored water containing at times 1,600 to 5,000 p.p.m. of chloride, and drinking water during these periods had to be procured elsewhere by the citizens. Improvements to make a tight dam had appeared impractical and other difficulties experienced with the water quality had been responsible for the present plan to abandon the source and turn to ground water and softening as related previously in Mr. Lohman's paper.

Sometimes the iron content of the water had been excessive; oxygen virtually absent and hydrogen sulphide sometimes present. Iron had at times passed the filters. To oxidize and remove the iron, super chlorination with liquid chlorine or chlorinated lime had given the best results. The use of permanganate had been tried, but was found less effective than heavy chlorination. Mr. Luther had observed that as long as the water did not contain above 300 p.p.m. chlorides salty tastes were not noticed and no complaints occurred.

(Lack of space prevents completion of this report. Papers on Sewage Treatment and the Round Table Discussion will be reported in our next issue.)

TASTES, CHLORINE AND CHLORAMINES IN WATER PURIFICATION

By CHAS. H. CAPEN, JR.

Consulting Engineer, West Orange, N. J.

BY means of high pressure salesmanship, intensive advertising campaigns and radio supplications, the sense of taste is being appealed to as never before. Even the most humble laborer may become a connoisseur, if he may believe the ads. The products thus exploited cover a wide variety of articles including tobacco, yeast, candy, coffee, soft drinks and many others. But, has anyone ever heard of the taste of water being advertised? No, decidedly not, and for very good reasons that will be hereinafter explained.

There are four main characteristics by which people judge the water that they drink. In the order noticed these are: physical appearance (such as color and turbidity), temperature, odor and taste. And the greatest of these is taste! Temperature may be accurately measured with a thermometer; color and turbidity may be determined within very narrow limits by comparison with suitably prepared standards; odor may be diagnosed fairly well by most people and quite well by trained observers; but taste is the elusive sprite of the water works field; the indescribable, unreliable something that appeals to no two persons in just the same way. Water that is pleasing to one person's palate may be equally revolting to another, much in the same way that certain foods appeal to some but are repelling to others. Odor and taste are closely related but their respective influences on the palatability of drinking water are not as inseparable as is generally believed. Much has been written about odors and tastes but consideration of the former usually predominates. The trend of this discussion will be in the opposite direction, for the reason that modern treatment methods permit a fairly reasonable control of physical appearance and odor but not necessarily of taste. (Temperature of course is not usually subject to any appreciable amount of control in the case of surface supplies and only to partial control in other cases.) The ultimate criterion of water, therefore, is the impression made after the palate has been affected, whereby the lingering sense of a pleasant or unpleasant sensation is noticed.

A person likes water cool, colorless and odorless but not tasteless. Most people would be immediately inclined to disagree with this last statement. Its validity can usually be proven by simply giving the doubter a glass of distilled water. Another proof is that the most popular bottled waters are generally those from wells containing a large amount of dissolved mineral salts and gases which impart a distinctive, although frequently unpronounced, taste.

Water is the one and only article of consumption that is sold to rich and poor alike at the same price and under the same conditions, with no one omitted. Would any food purveyor sell his product under such conditions and guarantee satisfaction to everyone? No, neither can the water works officials do so and since advertising implies a certain guarantee, men in charge of water works have learned not to advertise their wares. Without wishing to drag "family skeletons" before the readers too frequently, it may be said here that the shining example of the water works field that pride cometh before a fall, occurred in New York City about ten or twelve years ago. It must be first explained that New York City had done no bragging or ostentatious advertising of its water supply even though every citizen had a right to be proud of the excellence of it. A relatively small growth of Synura, causing a bitter taste after chlorination, occurred unexpectedly and unwelcomed. To say that these minute organisms caused a disagreeable disturbance is to put it mildly. The newspapers took up the cudgel for that ever ready critic, "the common people" and as usual the water department received much unwarranted criticism. A squib occurred in one of the humorous columns, typifying a striking, if biologically inaccurate, picture of the occasion. It read:

"My stomach is a dismal place
All liquid filled and dim
And round about in solemn rout
The sad synurae swim"

Experiences at that time, and since, have shown that an equally distasteful growth will occur in almost any surface water supply whenever natural conditions favor it, with the possibility of getting beyond control even when more than normal precautions are taken. Synura and many others are on the black list but their constant threat cannot be disregarded. This illustration is given for the purpose of demonstrating that no water supply can hope to attain the degree of purity and universal satisfaction claimed for many food products in modern advertising. The writer knows of no single surface water supply and very few underground supplies that have not at one time or another justified complaints from the consumers. It is small wonder therefore, that the water works man is chary of the use of ad-

The author of this article has had considerable experience with problems of water purification—first with a State Department of Health and later with a large water supply and also as consultant to smaller ones.

This, his first article, deals with the general problem of tastes; the relationship between temperature changes and chlorine requirement and the need of correlating these factors, with due appreciation of their significance in the practical operation of chlorinating stations.

He finds that critical points appear, during periods of receding water temperatures, at which chlorine dosages must be watched with care. At such periods, when chlorine alone is used, the margin between taste production of a chlorinous nature and the presence of sufficient residual chlorine for safety is narrowed perceptibly.

In the second part of this article, scheduled for a future issue, Mr. Capen will relate practical experiences with ammonia-chlorine treatment which resulted in overcoming this and other operating difficulties.

jectives in describing his supply.

Classification of Tastes

Tastes as experienced by the domestic consumer may be divided into two main groups which are given in the following tabulation, together with the more important of the subdivisions.

(I) *Natural Tastes*—[those due to the original condition of water]
- (a) Organic matter—
  - (1) From algae or other growths—[Woody-Earthy-Bitter-Grassy-Fishy-Oily]
  - (2) Organic deposits on the interior of pipes which when loosened sometimes give a taste—usually earthy but frequently worse.
  - (3) Sulphur taste from hydrogen sulphide due to organic decomposition.
- (b) Inorganic matter—
  - (1) Iron (in suspension only, as dissolved iron has little or no taste unless present in large quantities)
  - (2) Salts (usually calcium magnesium or sodium salts)
  - (3) Sulphur in suspension.

(II) *Artificial Tastes*—[those due to conditions imposed by man]
- (a) Chemical tastes — [Chlorine-Chloro-phenol-Chloro-organic-Alum-Lime-Trade Wastes]
- (b) Pipe tastes—[Lead-Iron-(styptic or metallic)-Zinc or Copper-(astringent)]

The first group was for a long time the principal one and has been known in practically all its phases for many years. Increased knowledge of the causes and exceptional care and preventative measures have reduced its significance and importance without, however, eliminating it from consideration. A modern, well operated filter plant, whether treating surface or underground water, will practically insure elmination of most of such tastes. The very presence of the plant, however, serves to introduce or augment those shown in the second group. Since the bulk of the supplies in the country of today are filtered, it follows that the artificial tastes are at present frequently the more important and the most troublesome.

The question naturally arises as to the proper category of trade wastes. Although they may be present in streams, they are man made and as such can only be considered artificial. Many people believe that tastes from trade-wastes can only be caused by the action of chlorine on products contained in the wastes, but this is not true. Nitro benzol and pyridine are two of the more important wastes with which the writer has had experiences, on which this assertion is made. Chlorine may, and often does, accentuate such tastes but is not necessarily responsible for all of them. The importance of trade wastes in this respect was well covered in a report by the Committee on Industrial Wastes in relation to water supply.(1)

Chlorine Terminology

In order to clarify the situation with respect to various terms used in connection with the effect of chlorine on tastes, the following definitions are given:

Chlorine dose—total rate of chlorine applied—usually expressed in parts per million. [1 part per million being 8.33 lbs. to one million gallons]

Residual chlorine—amount of chlorine remaining in water (as shown by orthotolidine reaction) after a period of contact of chlorine with water.

Chlorine demand—the difference between the preceding two, a period of contact having occurred, frequently twenty minutes.

Chlorine absorbed—a term generally synonomous with chlorine demand.

Chlorine assimilation point—a term not generally used but used in this discussion to indicate the maximum limit of chlorine dose permissable without causing some form of chlorine tastes.

Relation of Chlorine to Tastes

Chlorine, when present in sufficient quantities to give a taste due to nothing other than the chlorine, is only slightly objectionable. To those accustomed to it, the taste gives a sense of cleanliness and lends a somewhat psychological aid in the definite knowledge that the water is safe. It is not pleasing, however, and to some this taste renders the water unpalatable. Such a taste indicates a water dosed beyond the assimilation point.

Objectionable chloro tastes, such as chloro-organic and chloro-phenol tastes, may be present when the causative agents are present in very minute quantities. The tastes may be even revolting and nauseating. Under such conditions the assimilation point may be passed with even a ridiculously inadequate dosage of chlorine.

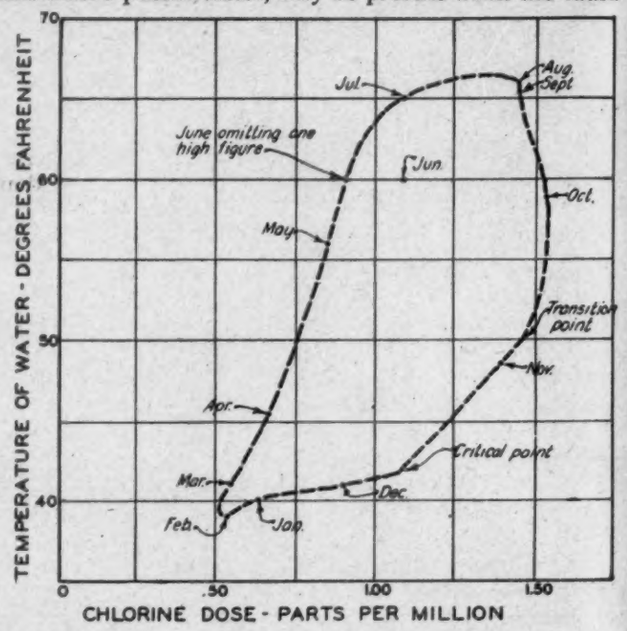


Fig. 1.—Curve Showing Relation of Chlorine Dose to Temperature. Average by Months Over a Period of Four Years.

It is the object of practically every modern water works man to produce a palatable, wholesome water that will meet the bacteriological standards set by the U. S. Treasury Department. In the effort to accomplish the latter requirement, it becomes almost inevitable that at some time or other, the use of chlorine becomes somewhat liberal and tastes sufficient to cause complaints result ie. the assimilation point is passed. The difficulty lies not with the operation but with the nature of the process and the affinity of chlorine for a variety of products. Until such time as an equally efficient process is perfected which will not create taste difficulties, chlorination will remain an absolutely vital part of modern water purification. So far, its position appears to be strengthened every year and under these circumstances it is necessary to find the most feasible means for overcoming the inherent fault of chlorine—namely, the production of tastes. In many instances ammonia added to the water, to bring about production of chloramines, has been

of marked value in raising the chlorine assimilation point. Its use for this purpose in the specific instance of a filtration plant will be given in the second part of this paper.

Temperature Effects.

In 1915, Mr. Glenn Ebaugh, then Assistant Sanitary Engineer of the New Jersey State Department of Health, conceived the idea of trying to correlate the factors governing the chlorine dosage required by different waters under varying conditions. He recognized that organic matter, iron, alkalinity and temperature all were important. A tabulation of results at that time showed vastly varying results for several reasons, chief of which were the lack of suitable standard methods of determining chlorine residuals and the unfamiliarity of operators with the use of liquid chlorine. The writer, during his term of service with the State Department of Health, fell heir to the task of trying to assemble all the data gathered by Mr. Ebaugh in usable form and the problem of drawing conclusions therefrom. It must be frankly admitted, that conflicting evidence led to the conclusion that each water was a law unto itself and that few general conclusions could be drawn. One point that was established, however, was that the required chlorine dosages varied considerably in any one supply during different seasons of the year. Incomplete data made it hazardous to draw definite conclusions as to the variation of the assimilation point of a given water under different temperature conditions.

In 1921 the conditions causing chlorinous tastes in water were discussed with Mr. George Spalding, Superintendent of the Hackensack Water Co. filtration plant, who stated that when the temperature of the water dropped below 46 degrees Fahrenheit in the autumn, only a relatively small quantity of residual chlorine could be safely carried without causing tastes. The assimilation point would be passed with anything more than a faint pink color as shown by the starch iodide test, which was in use at that time.

Observations made in the next few years, led to the belief that a critical point might exist, for filtered waters in particular, in which the residual must be confined within very narrow limits if tastes were to be avoided. These studies also showed that a second condition of decided lowering of the assimilation point occurred at a higher temperature which might be called the transition point. This is not as marked as the first but it is noticeable and often occurs between 48 and 52 degrees Fahrenheit.

In order to demonstrate this, a curve has been prepared, (Fig. 1), showing the relationship between temperature and the average chlorine dose by months, over a period of four years, at a filtration plant using prechlorination almost entirely. A fairly smooth curve resulted, and while it is true that there are no intermediate points plotted between 41 and 50 degrees Fahrenheit on the downward side to fully justify the bends shown there, this point will be further discussed in the second part of this article. The critical temperature in this case seems to be at about 42 degrees Fahrenheit. While of no particular significance, it is interesting to note that the curve somewhat resembles a hysteresis curve of iron and curves for individual years were far more marked in the resemblance.

It is also true that as temperatures are on the increase, a rapid increase in chlorine dose for a small change in temperature sometimes occurs. This condition, however, is by no means as marked as the change at the critical temperature but is frequently more marked than the transition point experienced with the decreasing temperature. This point of increasing demand is of less importance than the other two for the reason that tastes are not apt to be encountered at such times.

Another factor that is of great importance is the formation of ice. Two cases of winter tastes have been investigated which were directly attributable to the formation of ice on streams and reservoirs so that the normal processes of oxidation could not take place. Polluting material then used up all the oxygen available and produced a high chlorine demand, which if met, could only result in obnoxious tastes due to reaction between chlorine and the end products from anacrobic decomposition. Similar cases—notably that at Toledo, O.— have been described by others. Just how closely the formation of ice and the critical temperature are related has not yet been definitely determined. Unquestionably the formation of ice occurs at nearly the same time but observations up to the present time lead to the belief that it serves merely to aggravate the condition rather than cause it.

It must not be inferred that a fixed set of temperature conditions can be applied as a general rule covering all water supplies. However it is believed that a careful plotting of the results for any one supply will indicate a definite set of conditions, allied more closely to temperature than to any other condition, at which the necessity for marked changes in chlorine dosages may be looked for. This is more particularly true of filtered water supplies than non-filtered supplies and is also more true of a flowing stream than a large storage reservoir. The tendency of the latter is to delay the time at which these changes take place as well as to reduce their abruptness. Furthermore, the fall overturn of a reservoir, occurring as it usually does at a time of nearly maximum depletion, has a decided influence on the chlorine demand later in the fall than would be the case of a stream. The temperature also falls less rapidly so that the whole effect of a reservoir is to smooth out the peaks and valleys of chlorine consumption.

There are two factors which prevent these points from being even more pronounced. The first is the variation of natural chlorine demand during different seasons and the second is the human element. The first factor is closely allied to rainfall and runoff. During the early parts of the year, snowfall and spring rains add large volumes of water with relatively small amounts of impurities so that the chlorine demand of the water during the first four to six months of the year is low. The demand of stored waters increases slowly and reaches a peak during the period when streams are low and reservoirs depleted, generally reaching a maximum in October or November.

The human element introduces a condition which most water works men do not like to admit but which nevertheless has great influence in the use of chlorine. In the spring, the amenability of the water to sterilization with a relatively low dosage of chlorine, together with the desire of the operator to prevent tastes, causes the use of a minimum amount of the sterilizing agent. As the temperature and bacterial content increase, a point is often reached where some gas forming organisms get past the blockade set for them and the chlorine must be raised. A progressive series of these conditions occur until sometime in the Fall, usually in the latter part of November. At that time the diminishing temperature requires a reduction in chlorine and the series is repeated but with reverse effect. That is to say the

tendency is to hold the chlorine up above actual requirements until the limiting factor—tastes—necessitates drastic reduction in the rate of application.

Summary and Conclusions

Several years ago a schedule of tastes corresponding in type of notation to the designation of odors was devised and used to a limited extent by someone whose name is not recalled. A similar schedule based on modern requirements would aid greatly in comparing water supplies. The writer has used such a system with considerable success and suggests a comprehensive recognition and classification of tastes in Standard Methods. A classification of tastes such as that listed in the first part of this article would be used as a basis and any suitable designation chosen. For example 1-E-Pl would be a taste of the 1st order, earthy but nevertheless not unpleasing. 3-B-U would be a taste of the third order, bitter and unpleasant. The use of the letters Pl and U is somewhat superfluous as a 1 and 2 taste would generally be pleasant or fairly so while a 3 or 4 would be unpleasant.

Setting a chlorine dosage which is at once on the safe side of the chlorine assimilation point, and will at the same time insure efficient sterilization is often a difficult matter. The writer has solved two such cases by the use of ammonia and these will be discussed in a future article.

Temperature changes have a very important bearing on all chlorination problems and their significance does not appear to have been fully appreciated. A critical point seems to be reached at a temperature of about 44 degrees F. (varying possibly with each supply) whereupon chlorine dosages when used alone must be markedly reduced to avoid taste complaints. Further, a transition point often appears in the vicinity of 50 degrees F. whereupon the chlorine applied must be curtailed and therefrom gradually reduced until the critical point is reached when a marked reduction in chlorine demand should be looked for.

References

In the text only one reference is definitely mentioned. That is (1) "Progress Report of Committee on Industrial Wastes in Relation to Water Supply"—Jour. A.W.W.A. 10:415 (1923). Numerous papers and books have been read in connection with this subject and the more important are the following:

Books: Water Works Practice—Water Works Handbook—Microscopy of Drinking Water.

Articles: Howard: Jour. N.E.W.W.A. 3 (1926).
Donaldson: Jour. A.W.W.A. 9:885 (1922).
Moses: Jour. A.W.W.A. 25:1067 (1933).
Enslow: Jour. A.W.W.A. 18:630 (1927).
Enslow: Jour. A.W.W.A. 21:836 (1928).
Enslow: Water Works and Sewerage 78:55 (1931).
Harrison: Jour. A.W.W.A. 21:542 (1929).
Braidech: Ninth Annual Report, Ohio Conference on Water Purification (1929).

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Meter Reading and Billing at Hartford, Conn.

The following notes are taken from the 3rd annual report of the Water Bureau of Hartford, Conn. (the 79th of a series of annual reports of the water supply system of the city):

The office personnel consists of: A clerk appointed by the bureau, who acts as clerk of the bureau and performs such other duties as may be assigned him by the bureau. A vice-clerk, who acts as office manager for the clerk during his absence and is in direct charge of the meter reading section. An accountant and bookkeeper, who is responsible for receipts and disbursements and compiles a weekly financial sheet for the manager and a monthly statement for the bureau. A cashier, who receives water rents and other monies due the bureau. He also prepares the main pipe assessment charges and statements and miscellaneous billings, which include materials sold as an accommodation outside of the bureau. An assistant cashier, who relieves the cashier when absent or otherwise engaged, performs the stenographic work for the clerk and the duties of general office routine. An assistant cashier, who relieves the cashier and is responsible for all real estate transfers; also, the looking up and preparing of liens filed by the bureau for delinquent water accounts and keeping the addressograph plates correct and up to-date. A pay roll clerk, who prepares the weekly pay roll and checks and also assists in keeping the Kardex system up to-date, and general office routine. A posting clerk, who devotes all of his time to posting of water rents, which average approximately 4,300 entries monthly. These postings include the billings on ⅝-in., ¾-in., 1-in. and 1½-in. meters. A billing clerk, who bills and posts the so-called "large meters"—2 ins. or over in size—which approximate 600. These are billed monthly. This clerk acts as telephone and information operator; also, draws the checks (numbering about 700 a month) for discharging the bureau's obligations, and makes out the requisitions for department supplies. Another billing clerk, who bills meters from ⅝-in. to and including 1½-in.—about 4,300 monthly—also, assists in general office routine.

The meter reading force consists of an assistant foreman and six readers. The assistant foreman acts in the absence of the vice-clerk.

The territory is divided into seven zones, of which readings are taken every other month and billed semi-annually—the seventh zone comprising the larger meters, being read and billed monthly. Each reader averages about 100 meters daily.

Zone No. 1 is billed in Feb. and Aug.—Averages 3,672 meters.

Zone No. 2 is billed in Apr. and Oct.—Averages 4,434 meters.

Zone No. 3 is billed in June and Dec.—Averages 4,714 meters.

Zone No. 4 is billed in Mar. and Sept.—Averages 3,894 meters.

Zone No. 5 is billed in May and Nov.—Averages 4,652 meters.

Zone No. 6 is billed in Jan. and July—Averages 4,715 meters.

Each zone is placed in the mail the last day of the month and is due and payable the first day of the month following. On all water bills remaining unpaid twenty days after due, a penalty charge of 5 percent is added until the first of every month thereafter, when an additional 1 percent is added to the 5 percent until paid. The first of the following month after the bill is due, a delinquency notice is forwarded to the owner of the premises, with a request to pay within five days. After this period, the owner receives a registered letter to the effect that the bill be paid within a specified time or the water will be shut off. Before the water is again turned on, all back charges must be paid, plus a $2.00 fee for the service.

ROADSIDE DRINKING WATER AND PUBLIC COMFORT STATIONS

By JOHN R. BAYLIS

Physical Chemist, Bureau of Engineering, Chicago, Ill.

TRAVEL by automobile is increasing at a very rapid rate. More new paved roads are being constructed, existing roads are being widened, and grade crossings are being eliminated, yet in many sections of the country the roads are over-crowded with cars a large part of the time. Most of our highways are now carrying many times the number of persons between distant points than were ever carried by the railroads, and travel between nearby points by auto and busses is very much greater than that carried by other transportation facilities.

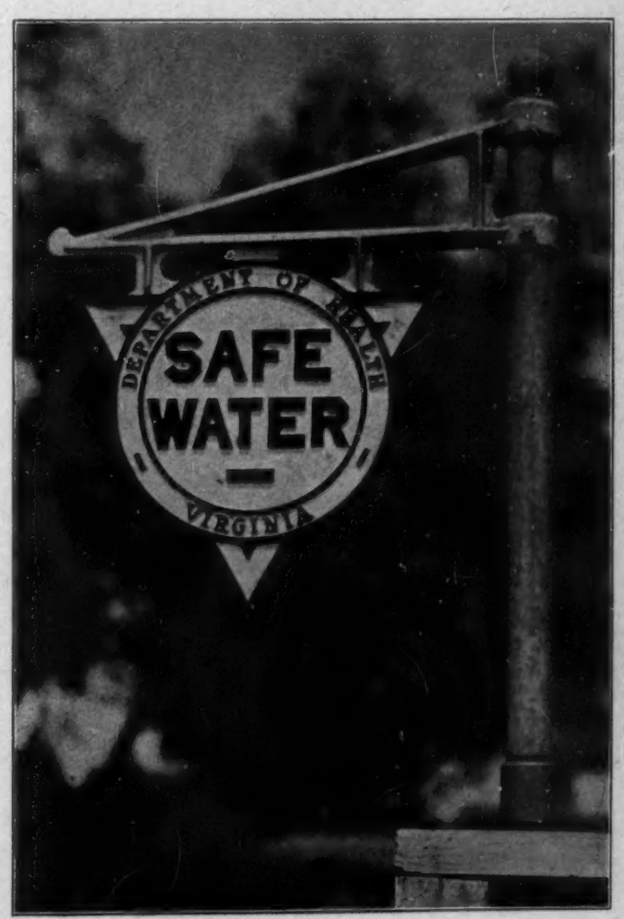
The problem of sanitation for this vast army of auto travelers is a very serious one and is destined to become still more serious as the number of travelers by automobile increase. Instead of staying at home in the evenings, Sundays, or at other times while not at work, many get into their cars and travel to some point ten, twenty, fifty or more miles away. Much of this travel is purely for the pleasure of driving, but many find it necessary to use comfort stations and to take a drink of water on such short trips. In some of the thickly populated sections of the country the only condition regulating the maximum number of cars on the roads is the fact that more cannot get on the road. Just as soon as more and wider highways are constructed travel in automobiles will increase materially.

Public Comfort Stations and Drinking Fountains Along Our Highways Are Inadequate.—Before the days of the automobile, people frequently congregated at certain points for pleasure and recreation. These points were stable and it was not difficult to provide fairly satisfactory sanitary conditions, though it was not done in many instances. Now our places of recreation are along the roadside everywhere an automobile can be driven. Provisions for drinking water for the multitude of travelers by car are very inadequate and in some instances constitute a menace to health. Other sanitary needs of the traveler also are very inadequate. When a person is traveling by train there is no choice to use accommodations other than those provided by the railroads, and it is to the credit of the railroads that these accommodations are usually good enough so that there is not much danger of contracting diseases while traveling by rail.

Many of the gasoline filling stations are doing the best they can to provide comfort stations and drinking water for automobile users. In many instances these accommodations are kept in a fairly sanitary condition and are about as safe as one may expect such stations to be under the circumstances. Too often we see, even in cities and towns, the common drinking cup and toilets without wash basins and paper towels. Where the common drinking cup is forbidden it usually is not difficult for the person purchasing a few gallons of gasoline to persuade the attendant to find a glass, which may or may not have been washed since being used last. Some of the stations have attempted to install sanitary drinking fountains, but frequently the type used is not entirely safe, though a great improvement over the common drinking cup or glass.

The Privy in the Rear Should Be Abolished.—The most serious situation is that many do not avail themselves of accommodations provided by the more up-to-date filling stations, and use no accommodations, or else those provided by the small country filling stations with the privy in the rear with seats about as unsanitary as they can be. Such stations usually have a bucket or pitcher of water drawn from a well or pump, which is frequently located not so far away from the privy, and usually a common glass or tin cup is provided for drinking. The occupants of the car which stops for gasoline visit the privy, then take a drink of "pure" well water. Perhaps a majority of those patronizing such filling stations are people from the country and small villages and are not accustomed to the use of water closets. It is only natural that many will seek accommodations similar to that which they are accustomed to using. Such filling station accommodations constitute a direct menace to health and should be forcefully eliminated as soon as practical unless improved comfort stations are provided by the proprietors.

The Farmer Goes Traveling.—Some years ago it might have been said that very few of the country people traveled a great distance and therefore needed to use comfort stations very little, but times have changed. Nearly every farmer and a large percentage of those residing in



A Road-Side Stamp of Water Supply Approval

small communities not equipped with sanitary sewers have cars of some kind, like those residing in large cities, and are beginning to travel long distances. At a time when there is a lull in rush work on the farm, the farmer loads a ham or two on the car, a side of bacon, a few dozen eggs, a bag of flour, a few jars or cans of canned goods, sugar, coffee and a few other things to eat; equipment for cooking, and baggage; and then they fill the balance of the space with passengers and start out to see the country. They expect to do their own cooking, and to sleep in tourist cabins or to camp out at night. Money for the trip is limited, and little is spent for things other than gasoline and oil.

If only $25.00 is available for the trip, many prefer to spend most of the amount on gasoline and oil and take an 800 to 1,200 mile trip rather than shorten the trip and sleep in hotels and eat in restaurants. Who can blame those with limited means for getting the most sight-seeing possible out of a certain sum of money? The writer would do the same thing. Unbalanced meals and uncomfortable sleeping places for a few nights probably will hurt no one, certainly it will not overbalance the good the trip will do one. It is interesting to see the increasing number of cars carrying living quarters attached to the car. These cars are parked somewhere every night while on the trip, and those using the traveling home must patronize roadside comfort stations or use the open woods. If they go to the trouble and expense of pulling their living quarters around with them they are not going to park at night where the cost of parking is more than a very small sum. Frequently they used no public parking space.

Traveling By the Cheaper Method Will Increase.—There is every indication that travel by the cheaper method is going to increase enormously in the future, and it becomes imperative that sanitary engineers and public health officials see that such travel is not likely to be the means of transmitting diseases. On a recent trip of several days' duration the writer saw license plates from every state in the United States except five, and cars from these five states probably passed but they were going so fast the names of the states could not be distinguished. Unsanitary toilets and impure drinking water in filling stations are more likely to transmit diseases to persons from distant points than to those living in the immediate vicinity, for those in the immediate vicinity most likely do not avail themselves of such accommodations nearly as frequently as those from distant points.

The car of the future for cross country travel probably will be one which will provide sleeping quarters at night and a means of transportation during the day. More and more of our citizens will travel in this manner. Safe accommodations for this type of travel must be provided, and it must be the type of accommodation that will be utilized. Such accommodations must be free to the motorists, and there must be no expectation that the motorist will purchase anything for the privilege of using the comfort stations. It is not believed that we can rely upon all gasoline filling stations to provide adequate and safe comfort stations along our roadsides, and it really is not their duty to provide such accommodations.

Public Comfort Stations and Drinking Water Should Be Provided by the States.—There can be but one satisfactory solution of the roadside sanitation problem, and that is for the states to construct and maintain adequate comfort stations at intervals along all state roads so that it will not be necessary for one to patronize accommodations at other places. In addition to public comfort stations, adequate camping sites should also be provided at sufficiently frequent intervals along the roadside. Adequate road signs should indicate the distance to the next one on the route. The traveling public would probably be willing to pay a very small sum for the privilege of camping at such places. There is one thing, however, the public is not willing to do and that is to pay for the use of public comfort stations.

The cost of constructing and operating public comfort stations and providing safe drinking water along the roadsides should be the duty of the state highway departments. Such accommodations should be regarded as an essential adjunct to the highway. Much money is spent for signs along the roads to make traveling more safe, yet nothing, or almost nothing is spent by the highway departments for sanitation to help protect the health or provide for the comfort of travelers.

The Federal authorities should immediately insist upon adequate sanitation along the roadsides of all roads receiving Federal aid, and the departments of health of the various states should immediately start a campaign directed at the state highway departments to construct public comfort stations and to provide safe drinking water. It is difficult to state how far apart such stations should be located. For the heavy traveled roads it is believed that 25 to 30 miles apart is none too frequent, and for the lesser traveled roads 50 to 60 miles apart would give accommodations better than nothing. It should be the aim to eventually locate stations between these longer points.

The Problem is Difficult.—The problem of providing adequate, safe, and palatable drinking water at points along the roadside other than in cities and towns having public supplies is a difficult one, for the sterilization of small quantities of drinking water is not an easy task. Cities and towns with public supplies occur along some of the roads frequently enough to be adequate for drinking fountains. A few cities and towns already have constructed public drinking fountains for the convenience of the auto travelers, and it is a service greatly appreciated by those passing through such places. Occasionally we find a public comfort station along the highway in some small city, but there are very few such stations.

A system of public comfort stations and drinking fountains maintained by the state highway departments is believed to be the best solution of the problem. Sanitary engineers should take the lead in convincing the highway officials of the importance of improving sanitation for our auto travelers. The cost of operating such stations should come from the taxes on gasoline and automobiles, just as the cost of public comfort accommodations and drinking water in railroad stations and on trains is taken care of by the price paid to ride on the train. Regardless of the manner in which we pay for our drinking water, and the manner in which we pay for the use of toilets, the cost must be borne largely by those using such facilities. Payment of the cost of such accommodations for the auto travelers out of the gas tax is about as fair a method of spreading the cost as can be suggested because it is a fact that the public will not tolerate a direct charge.

Should the present system of using facilities provided by filling stations be continued, and the facilities be improved in stations where they are inadequate, the cost of providing such accommodations must be added to the cost of distributing the gasoline and oil. The attendants in gasoline filling stations too often feel that it is their duty to sell gasoline and oil and resent having to look after the toilets. Consequently the toilets in many stations are neglected. Can the filling stations be made to provide clean and sanitary comfort stations should

they choose not to do so? Is it not a voluntary service in which they would resent strict regulations by the health departments which would result in many stations not providing such accommodations? Every gasoline filling station should be required to install up-to-date public comfort stations so that all filling stations would be on the same terms, or as a better solution, such stations should be provided by the state. The thing that is urgently needed at the present time is to improve roadside sanitation. Several states have already accomplished something in this direction but more of it is sorely needed.

NRA Releases of Information Covering Loans and Grants to Cities for Water Works and Sewerage Projects*

RELEASE NO. 10

Location and Project	Loan-Grant	Amount
Portland, Ore.—Watermains	L and G	$15,435
Fayetteville, W. Va.—Reservoir, filtration plant, distributing system	L and G	67,000
Washington, Ind.—Sewer system	L and G	150,000
Rochester, N. H.—Waterworks	L and G	240,000
Prairie Grove, Ark.—Water supply system	L and G	60,000
Reading, Hamilton Co., Ohio—Softening plant and additional well supply	L and G	37,000
Junction City, Ark.—Water system	L and G	38,000
Victoria, Ark.—Waterworks	L and G	36,000
Grand View Heights, Ohio—Waterworks	L and G	86,000
Mitchell, S. D.—Sewerage	L and G	174,000
Meriden, Conn.—Sewer extension	Grant	47,000
Barre, Vt.—Surface sewers	Grant	7,000
Barre, Vt.—Sewerage	Grant	7,000
Cincinnati, Ohio—Sewerage	Grant	600
Cincinnati, Ohio—Sewerage	Grant	800
Cincinnati, Ohio—Intercepting sewer	Grant	11,700
Cincinnati, Ohio—Sewerage	Grant	13,500
Longmont, Colo.—Filtration plant and replacing pipe	Grant	190,000
Hartford, Conn.—Sewerage	Grant	800,000
Michigan City, Ind.—Filtration plant, storage tank and mains	L and G	413,000
Hyattsville, Md.—Extension water mains and sewers	L and G	650,000
Summersville, W. Va.—Construction of water and sewer systems	L and G	32,000
Malone, N. Y.—Sewerage	L and G	100,000
Baltimore, Md.—Water mains	Grant	22,000
Lovelock, Nev.—Well, pumping system and pipe replacement	L and G	106,000
Boulder, Colo.—Clarification works for sewage	L and G	72,000
Alameda, Idaho—Waterworks and reservoir	L and G	35,000
Steubenville, Ohio—Waterworks	L and G	105,000
Waldron, Ark.—Waterworks	L and G	51,000
Columbus, Nebr.—Sewerage	L and G	75,000
Aurora, Mo.—Sewerage	L and G	33,000
Elizabethtown, Ky.—Sanitary sewage system	L and G	90,000
North Adams, Mass.—Sewerage	L and G	374,000
Kennett Square—Sewerage	L and G	120,000
Ellensburg, Wash.—Water mains, trunk sewer	Grant	3,000
Redwood City, Calif.—Reservoir and water lines	Grant	5,000
North Andover, Mass.—Water mains	Grant	4,300
Pond Creek, Okla.—Piping; moving water mains	Grant	900
O'Neill, Nebr.—Well; pump house, water main	Grant	1,500
West Hartford, Conn.—Trunk sewer	Grant	74,000
Lawrence, Kans.—Water works	Grant	4,800
Brigham City, Utah—Reservoir	Grant	4,200
Loveland, Colo.—Waterworks	Grant	3,800
Shoshone, Idaho.—Waterworks	Loan	180,000
Milwaukee, Wis.—Water purification plant	L and G	4,600,000
Madison, Wis.—Connecting wells to water system	L and G	183,200
Columbia, S. C.—Sewer system and water mains	L and G	893,000
Reading, Pa.—Waterworks	L and G	2,550,000
Granite Falls, N. C.—Waterworks	L and G	55,000
Greenwood, S. C.—Dam; pumping station; filtration plant; water mains	L and G	200,000
Commonwealth of Massachusetts—Sewage systems	L and G	216,000
Limon, Colo.—Water mains; tank	L and G	41,000
Fallon, Nev.—Well; piping; reservoir	L and G	100,000
Olathe, Colo.—Waterworks	L and G	25,000
Kenosha, Wis.—Waterworks	L and G	189,000
Footville, Wis.—Water and sewer systems	L and G	30,000
Goshen, N. Y.—Waterworks	L and G	155,000
Carlisle, Ark.—Complete water system	L and G	60,000
Elgin, Ill.—Reservoir and water system extension	L and G	82,000
New Cumberland, W. Va.—Water system extension	L and G	63,000
Point Pleasant, W. Va.—Sewerage	L and G	116,000
Ionia, Mich.—Reservoir, piping, water system extension	L and G	70,000
Wakefield, Mass.—Pipe replacement	L and G	100,000
Burlington, Vt.—Sewerage	Grant	9,700
Vandalia, Ill.—Storage tank; pipe lines	Grant	4,600
Linden, Texas—Water and sewerage	L and G	50,000
Platteville, Wis.—Sewerage	L and G	33,000
Cudahy, Wis.—Storm relief sewer system	L and G	350,000
Wellington, Kans.—Sewerage	L and G	83,000
Clinton, Ill.—Sewerage	L and G	135,000
Cobden, Ill.—Waterworks system	L and G	70,000
Danville, W. Va.—Reservoir, water distribution system	L and G	22,000
McKinney, Texas—Well; extension of water system	L and G	51,000
Honolulu, T. H.—Water system improvement	Grant	62,000
Lynchburg, Va.—C. I. pipe line	L and G	600,000
Lexington, Mass.—Intercepting sewers	Grant	11,000
Evanston, Ill.—Reservoir	L and G	150,000
Crownsville, Md.—Water tank and mains	Grant	7,400
Jefferson City, Mo.—Sewerage	Grant	9,000
Columbia, Mo.—Reservoir	Grant	15,300
Butler, Mo.—Sanitary sewers	Grant	3,000

RELEASE NO. 13

Durham, N. C.—Sewer extension (see Project Add. List No. 8, $710,000)	L and G	$50,000
Tacoma, Wash.—Water supply conduit	L and G	1,000,000
Cottage City, Md.—Storm pipe sewers	L and G	72,000
Greenfield, Ind.—Sewerage	L and G	48,000
Worcester, Mass.—Sewerage	Grant	66,000
Auburn, Ill.—Water system	L and G	299,000
Pawnee, Ill.—Waterworks	L and G	74,000
Chatham, Ill.—Waterworks	L and G	63,000
Council Bluffs, Iowa—Extension water system	Grant	29,000
Windsor, Ill.—Waterworks	L and G	65,000
Hamilton, Ohio—Wells, force mains; reservoir construction	L and G	850,000
New Cumberland, W. Va.—Sewer system extension	L and G	28,000
Stonington, Ill.—Waterworks extension	L and G	30,000
Houston, Texas—Waterworks extension	L and G	2,502,000
Ligonier, Ind.—Repairs and extensions to waterworks	L and G	27,000
Muskogee, Okla.—Repairs to water basins, intake and reservoir; filter plant	L and G	165,000
Appleton, Minn.—Sewerage	L and G	44,000
Perth Amboy, N. J.—Sewerage	L and G	859,000
Moweaqua, Ill.—Water distribution extension; fire hydrants	L and G	9,000
Ouray, Colo.—Water system; extension; pipe replacement	L and G	18,000
Guthrie Center, Iowa—Sewage improvements	Grant	400
Atlantic, Iowa—Water system extension	Grant	8,100
Marshalltown, Iowa—Storm sewers	Grant	2,500
Decorah, Iowa—Water system extension	Grant	6,000
Redwood Falls, Minn.—Sewerage	Grant	6,000
Holdrege, Nebr.—Repairs and improvements to sewage disposal plant	Grant	3,000
Salina, Kans.—Pumping station	Grant	6,000
Miami, Fla.—Water system improvements	L and G	560,000
Glen Rock, N. J.—Sewer extension	L and G	22,000
Weston, Idaho—Water mains	L and G	14,000

*Releases Number 1 to 9 inclusive were published in the November issue of WATER WORKS AND SEWERAGE.

EDITORIALS

Putting Civil Works Grant Money to Good Use

IN addressing the joint meeting of the North Carolina Section of the American Water Works Association and the North Carolina Sewage Works Association, reported elsewhere in this issue, Frank Page, Chairman of the P. W. A. State Advisory Board, laid emphasis on the fact that municipal officials had been paying too much attention to the outcry of short-sighted and recalcitrant taxpayers objecting to cities spending money for any purpose. The result had been the neglect of important capital investments in municipally owned and operated utility properties. Neglect, he said, in the matter of needed replacements and adequate maintenance in connection with the operation of such properties had, in numerous cases, reached a point representing false economy and therefore he sounded a warning note to municipal authorities that something should be done immediately to correct the situation.

Mr. Page was specifically referring to conditions prevailing in North Carolina, of which he had first hand information, but this same situation may be found to a greater or lesser degree in municipalities over the country at large. Moreover, it is not hazardous to say that privately owned water companies have not been entirely free from the same practice of false economy in recent times. However, in comparing the appearance of privately operated water properties, recently, with those municipally owned, it is apparent that the stockholder has been more fortunate in having his investment protected than has Mr. John Q. Taxpayer.

What is the reason for this? Are managers and superintendents of municipal utilities doing their utmost to prove to their boards, councils or commissions the false economy of continued curtailment of maintenance and delay in needed replacements of equipment and machinery? Are they afraid to do a bit of "table pounding" for betterments they know to be needed; or, have they become too discouraged, because of repeated failures in previous attempts, to go to the mat again with their recommendations? Have they made their case sufficiently plain? Or, have repeated attempts to get improvements been met with the reply, that—admitting the need—because of uncollected water rents and taxes or the necessity of reducing water rates, there were no funds for the desired work until conditions improved.

Superintendents of water works and sewerage will find the funds available through the new Civil Works Administration an answer in part to their problem of how to finance much of the needed maintenance and repair work around plants, on sewers and on water distribution system. The $400,000,000 Civil Works Fund, diverted from the P. W. A. appropriation to be distributed in the form of grants to municipalities, is available for such use without strings or red tape. Further, no borrowing is required in order to secure such grants. The use to which the grant is put has only to be approved by the State Administrator of Civil Works and thereby approval of the planned work and the money may be quickly gotten. The major requirement is that the money be spent in putting men to work promptly and that little if any of it be spent for purchase of materials.

If it be necessary to answer the question, "What can be done with men and no equipment or materials?": In lieu of other sources of purchase money one answer which suggests itself is, that the municipality being relieved of providing a Works Relief Fund if procuring Civil Works money, might well afford to divert money from the former to supplement the Federal money in order to purchase needed materials such as paint, tools, instruments, cement, pipe, fittings and the like. It becomes a matter of transferring money from one pocket to another.

Such work as painting of standpipes, tanks and other equipment or structures; extensions to sewers and water mains; stopping erosion on water-shed areas; replacing house service lines; amplifying meter testing and repair programs; making leak surveys; overhauling filters; and repairs in general, are examples of work that can be financed from Civil Works funds.

Grounds surrounding water works and sewerage properties are in many instances not overly pleasing to the eye. Improvements in the way of beautification of plants and other municipal properties is not costly when one considers the fact that nearby fields and forests yield shrubs, trees and plants which are most satisfactory for beautification in view of the fact that these are indigenous to the soil and climate—and are thereby superior to cultivated varieties on that score. The use of fieldstone and other local materials, which do not require more than labor, and truck to gather and use, are most successfully employed in beautification work. Attractive utility properties build good will on the part of the consumer and taxpayer and once a beautification program is started many gifts of shrubs and flowers from interested citizens follow. Sewage treatment works have been successful in trading fertilizing sludge in exchange for shrubs and plants from nurseries and florists. It will be surprising to see how, once started, the plan of beautification becomes self propelling—the use of Civil Works funds for getting started represents an opportunity not to be overlooked.

Further than this, it was the expressed opinion of Col. J. A. Anderson, State P. W. A. Engineer for Virginia, as reported elsewhere in this issue, that municipalities so bad off financially as not to be able to finance water works and sewerage projects through P. W. A. channels would most likely be permitted to use Civil Works money for labor and engineering on major projects, including new systems or treatment works.

Of interest to many municipalities is the fact that Civil Works money is intended to give employment to the white collar worker and the professional man as well as skilled and common law. This situation presents an opportunity for municipalities to procure needed surveys, engineering reports, recommendations and estimates to cover extensions and improvements to existing water works and sewerage facilities. Making such use of Civil Works money will thus pay a good part, if not all, of the cost of investigations and plans, looking toward new sources of supply or entire new systems or treatment works. For the small village, too poor to pay for engineering services otherwise, the Civil Works grant should make it possible now to employ engineers.

small communities not equipped with sanitary sewers have cars of some kind, like those residing in large cities, and are beginning to travel long distances. At a time when there is a lull in rush work on the farm, the farmer loads a ham or two on the car, a side of bacon, a few dozen eggs, a bag of flour, a few jars or cans of canned goods, sugar, coffee and a few other things to eat; equipment for cooking, and baggage; and then they fill the balance of the space with passengers and start out to see the country. They expect to do their own cooking, and to sleep in tourist cabins or to camp out at night. Money for the trip is limited, and little is spent for things other than gasoline and oil.

If only $25.00 is available for the trip, many prefer to spend most of the amount on gasoline and oil and take an 800 to 1,200 mile trip rather than shorten the trip and sleep in hotels and eat in restaurants. Who can blame those with limited means for getting the most sight-seeging possible out of a certain sum of money? The writer would do the same thing. Unbalanced meals and uncomfortable sleeping places for a few nights probably will hurt no one, certainly it will not overbalance the good the trip will do one. It is interesting to see the increasing number of cars carrying living quarters attached to the car. These cars are parked somewhere every night while on the trip, and those using the traveling home must patronize roadside comfort stations or use the open woods. If they go to the trouble and expense of pulling their living quarters around with them they are not going to park at night where the cost of parking is more than a very small sum. Frequently they used no public parking space.

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Hartford, Conn.—Sewerage	Grant	800,000
Michigan City, Ind.—Filtration plant, storage tank and mains	L and G	413,000
Hyattsville, Md.—Extension water mains and sewers	L and G	650,000
Summersville, W. Va.—Construction of water and sewer systems	L and G	32,000
Malone, N. Y.—Sewerage	L and G	100,000
Baltimore, Md.—Water mains	Grant	22,000
Lovelock, Nev.—Well, pumping system and pipe replacement	L and G	106,000
Boulder, Colo.—Clarification works for sewage	L and G	72,000
Alameda, Idaho—Waterworks and reservoir	L and G	35,000
Steubenville, Ohio—Waterworks	L and G	105,000
Waldron, Ark.—Waterworks	L and G	51,000
Columbus, Nebr.—Sewerage	L and G	75,000
Aurora, Mo.—Sewerage	L and G	33,000
Elizabethtown, Ky.—Sanitary sewage system	L and G	90,000
North Adams, Mass.—Sewerage	L and G	374,000
Kennett Square—Sewerage	L and G	120,000
Ellensburg, Wash.—Water mains, trunk sewer	Grant	3,000
Redwood City, Calif.—Reservoir and water lines	Grant	5,000
North Andover, Mass.—Water mains	Grant	4,300
Pond Creek, Okla.—Piping; moving water mains	Grant	900
O'Neill, Nebr.—Well; pump house, water main	Grant	1,500
West Hartford, Conn.—Trunk sewer	Grant	74,000
Lawrence, Kans.—Water works	Grant	4,800
Brigham City, Utah—Reservoir	Grant	4,200
Loveland, Colo.—Waterworks	Grant	3,800
Shoshone, Idaho.—Waterworks	Loan	180,000
Milwaukee, Wis.—Water purification plant	L and G	4,600,000
Madison, Wis.—Connecting wells to water system	L and G	183,200
Columbia, S. C.—Sewer system and water mains	L and G	893,000
Reading, Pa.—Waterworks	L and G	2,550,000
Granite Falls, N. C.—Waterworks	L and G	55,000
Greenwood, S. C.—Dam; pumping station; filtration plant; water mains	L and G	200,000
Commonwealth of Massachusetts—Sewage systems	L and G	216,000
Limon, Colo.—Water mains; tank	L and G	41,000
Fallon, Nev.—Well; piping; reservoir	L and G	100,000
Olathe, Colo.—Waterworks	L and G	25,000
Kenosha, Wis.—Waterworks	L and G	189,000
Footville, Wis.—Water and sewer systems	L and G	30,000
Goshen, N. Y.—Waterworks	L and G	155,000
Carlisle, Ark.—Complete water system	L and G	60,000
Elgin, Ill.—Reservoir and water system extension	L and G	82,000
New Cumberland, W. Va.—Water system extension	L and G	63,000
Point Pleasant, W. Va.—Sewerage	L and G	116,000
Ionia, Mich.—Reservoir, piping, water system extension	L and G	70,000
Wakefield, Mass.—Pipe replacement	L and G	100,000
Burlington, Vt.—Sewerage	Grant	9,700
Vandalia, Ill.—Storage tank; pipe lines	Grant	4,600
Linden, Texas—Water and sewerage	L and G	50,000
Platteville, Wis.—Sewerage	L and G	33,000
Cudahy, Wis.—Storm relief sewer system	L and G	350,000
Wellington, Kans.—Sewerage	L and G	83,000
Clinton, Ill.—Sewerage	L and G	135,000
Cobden, Ill.—Waterworks system	L and G	70,000
Danville, W. Va.—Reservoir, water distribution system	L and G	22,000
McKinney, Texas—Well; extension of water system	L and G	51,000
Honolulu, T. H.—Water system improvement	Grant	62,000
Lynchburg, Va.—C. I. pipe line	L and G	600,000
Lexington, Mass.—Intercepting sewers	Grant	11,000
Evanston, Ill.—Reservoir	L and G	150,000
Crownsville, Md.—Water tank and mains	Grant	7,400
Jefferson City, Mo.—Sewerage	Grant	9,000
Columbia, Mo.—Reservoir	Grant	15,300
Butler, Mo.—Sanitary sewers	Grant	3,000

RELEASE NO. 13

Durham, N. C.—Sewer extension (see Project Add. List No. 8, $710,000)	L and G	$50,000
Tacoma, Wash.—Water supply conduit	L and G	1,000,000
Cottage City, Md.—Storm pipe sewers	L and G	72,000
Greenfield, Ind.—Sewerage	L and G	48,000
Worcester, Mass.—Sewerage	Grant	66,000
Auburn, Ill.—Water system	L and G	299,000
Pawnee, Ill.—Waterworks	L and G	74,000
Chatham, Ill.—Waterworks	L and G	63,000
Council Bluffs, Iowa—Extension water system	Grant	29,000
Windsor, Ill.—Waterworks	L and G	65,000
Hamilton, Ohio—Wells, force mains; reservoir construction	L and G	850,000
New Cumberland, W. Va.—Sewer system extension	L and G	28,000
Stonington, Ill.—Waterworks extension	L and G	30,000
Houston, Texas—Waterworks extension	L and G	2,502,000
Ligonier, Ind.—Repairs and extensions to waterworks	L and G	27,000
Muskogee, Okla.—Repairs to water basins, intake and reservoir; filter plant	L and G	165,000
Appleton, Minn.—Sewerage	L and G	44,000
Perth Amboy, N. J.—Sewerage	L and G	859,000
Moweaqua, Ill.—Water distribution extension; fire hydrants	L and G	9,000
Ouray, Colo.—Water system; extension; pipe replacement	L and G	18,000
Guthrie Center, Iowa—Sewage improvements	Grant	400
Atlantic, Iowa—Water system extension	Grant	8,100
Marshalltown, Iowa—Storm sewers	Grant	2,500
Decorah, Iowa—Water system extension	Grant	6,000
Redwood Falls, Minn.—Sewerage	Grant	6,000
Holdrege, Nebr.—Repairs and improvements to sewage disposal plant	Grant	3,000
Salina, Kans.—Pumping station	Grant	6,000
Miami, Fla.—Water system improvements	L and G	560,000
Glen Rock, N. J.—Sewer extension	L and G	22,000
Weston, Idaho—Water mains	L and G	14,000

*Releases Number 1 to 9 inclusive were published in the November issue of WATER WORKS AND SEWERAGE.

EDITORIALS

Putting Civil Works Grant Money to Good Use

IN addressing the joint meeting of the North Carolina Section of the American Water Works Association and the North Carolina Sewage Works Association, reported elsewhere in this issue, Frank Page, Chairman of the P. W. A. State Advisory Board, laid emphasis on the fact that municipal officials had been paying too much attention to the outcry of short-sighted and recalcitrant taxpayers objecting to cities spending money for any purpose. The result had been the neglect of important capital investments in municipally owned and operated utility properties. Neglect, he said, in the matter of needed replacements and adequate maintenance in connection with the operation of such properties had, in numerous cases, reached a point representing false economy and therefore he sounded a warning note to municipal authorities that something should be done immediately to correct the situation.

Mr. Page was specifically referring to conditions prevailing in North Carolina, of which he had first hand information, but this same situation may be found to a greater or lesser degree in municipalities over the country at large. Moreover, it is not hazardous to say that privately owned water companies have not been entirely free from the same practice of false economy in recent times. However, in comparing the appearance of privately operated water properties, recently, with those municipally owned, it is apparent that the stockholder has been more fortunate in having his investment protected than has Mr. John Q. Taxpayer.

What is the reason for this? Are managers and superintendents of municipal utilities doing their utmost to prove to their boards, councils or commissions the false economy of continued curtailment of maintenance and delay in needed replacements of equipment and machinery? Are they afraid to do a bit of "table pounding" for betterments they know to be needed; or, have they become too discouraged, because of repeated failures in previous attempts, to go to the mat again with their recommendations? Have they made their case sufficiently plain? Or, have repeated attempts to get improvements been met with the reply, that—admitting the need—because of uncollected water rents and taxes or the necessity of reducing water rates, there were no funds for the desired work until conditions improved.

Superintendents of water works and sewerage will find the funds available through the new Civil Works Administration an answer in part to their problem of how to finance much of the needed maintenance and repair work around plants, on sewers and on water distribution system. The $400,000,000 Civil Works Fund, diverted from the P. W. A. appropriation to be distributed in the form of grants to municipalities, is available for such use without strings or red tape. Further, no borrowing is required in order to secure such grants. The use to which the grant is put has only to be approved by the State Administrator of Civil Works and thereby approval of the planned work and the money may be quickly gotten. The major requirement is that the money be spent in putting men to work promptly and that little if any of it be spent for purchase of materials.

If it be necessary to answer the question, "What can be done with men and no equipment or materials?": In lieu of other sources of purchase money one answer which suggests itself is, that the municipality being relieved of providing a Works Relief Fund if procuring Civil Works money, might well afford to divert money from the former to supplement the Federal money in order to purchase needed materials such as paint, tools, instruments, cement, pipe, fittings and the like. It becomes a matter of transferring money from one pocket to another.

Such work as painting of standpipes, tanks and other equipment or structures; extensions to sewers and water mains; stopping erosion on water-shed areas; replacing house service lines; amplifying meter testing and repair programs; making leak surveys; overhauling filters; and repairs in general, are examples of work that can be financed from Civil Works funds.

Grounds surrounding water works and sewerage properties are in many instances not overly pleasing to the eye. Improvements in the way of beautification of plants and other municipal properties is not costly when one considers the fact that nearby fields and forests yield shrubs, trees and plants which are most satisfactory for beautification in view of the fact that these are indigenous to the soil and climate—and are thereby superior to cultivated varieties on that score. The use of fieldstone and other local materials, which do not require more than labor, and truck to gather and use, are most successfully employed in beautification work. Attractive utility properties build good will on the part of the consumer and taxpayer and once a beautification program is started many gifts of shrubs and flowers from interested citizens follow. Sewage treatment works have been successful in trading fertilizing sludge in exchange for shrubs and plants from nurseries and florists. It will be surprising to see how, once started, the plan of beautification becomes self propelling—the use of Civil Works funds for getting started represents an opportunity not to be overlooked.

Further than this, it was the expressed opinion of Col. J. A. Anderson, State P. W. A. Engineer for Virginia, as reported elsewhere in this issue, that municipalities so bad off financially as not to be able to finance water works and sewerage projects through P. W. A. channels would most likely be permitted to use Civil Works money for labor and engineering on major projects, including new systems or treatment works.

Of interest to many municipalities is the fact that Civil Works money is intended to give employment to the white collar worker and the professional man as well as skilled and common law. This situation presents an opportunity for municipalities to procure needed surveys, engineering reports, recommendations and estimates to cover extensions and improvements to existing water works and sewerage facilities. Making such use of Civil Works money will thus pay a good part, if not all, of the cost of investigations and plans, looking toward new sources of supply or entire new systems or treatment works. For the small village, too poor to pay for engineering services otherwise, the Civil Works grant should make it possible now to employ engineers.

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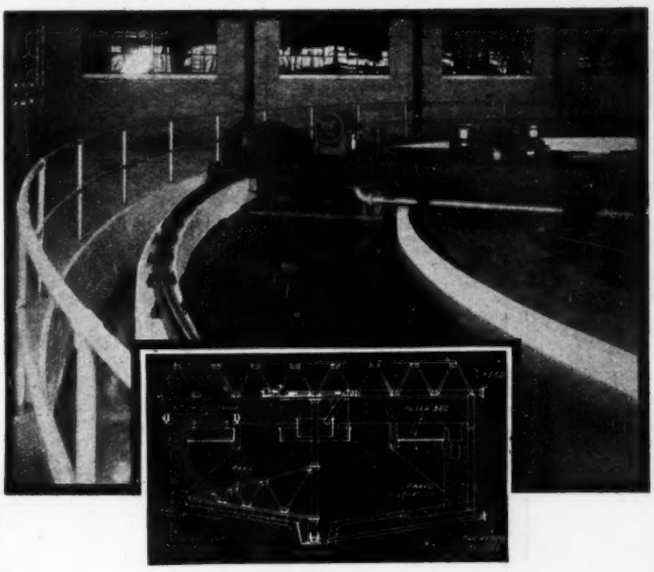

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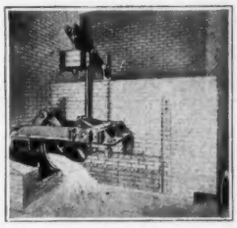

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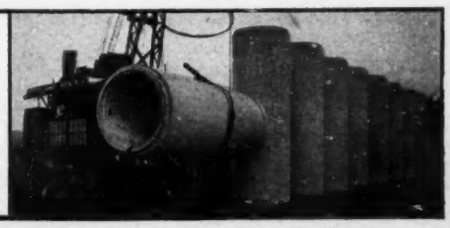

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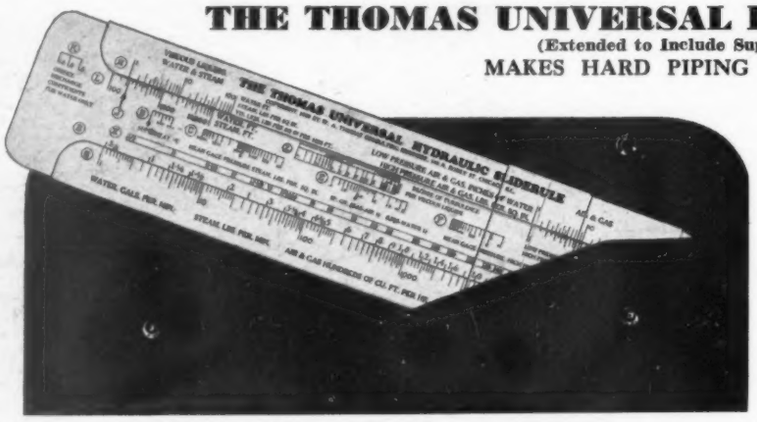

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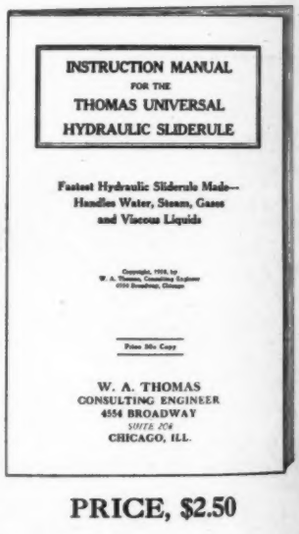

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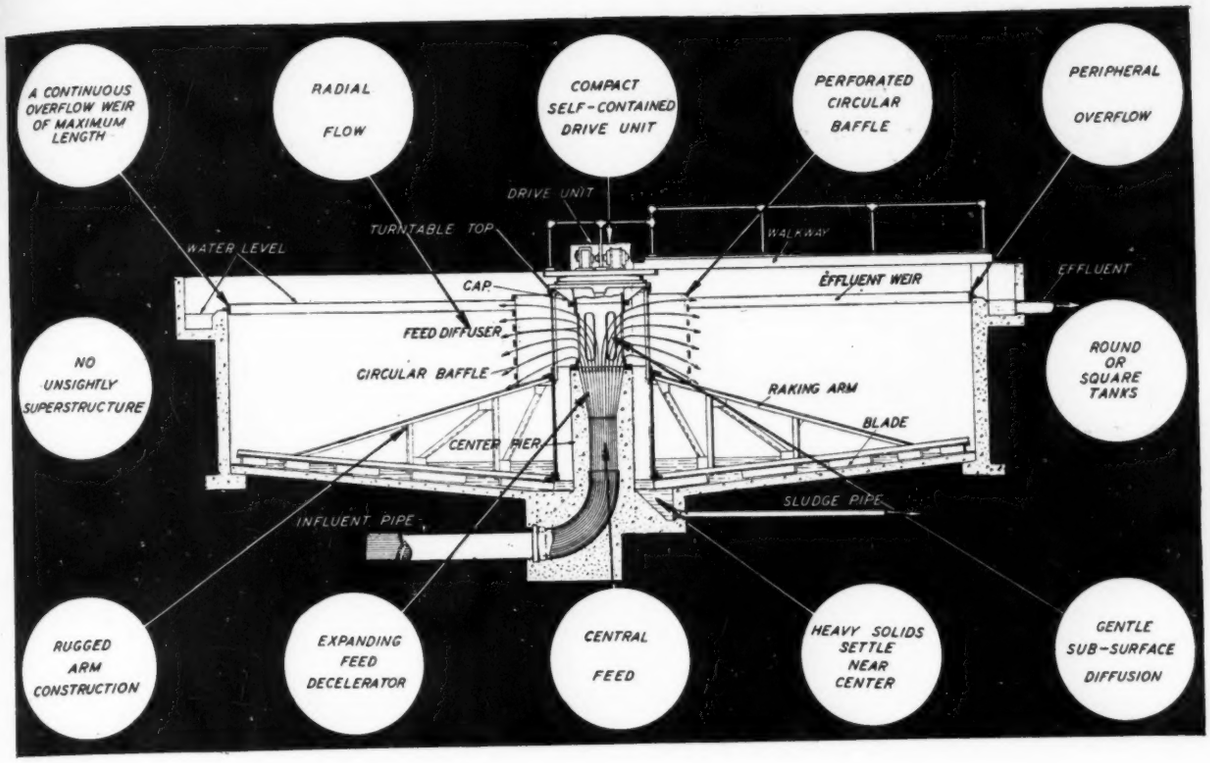

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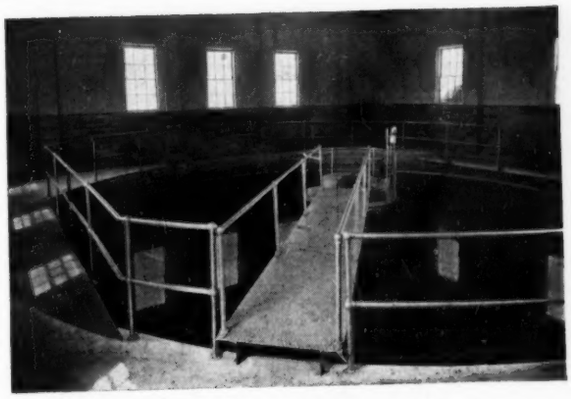

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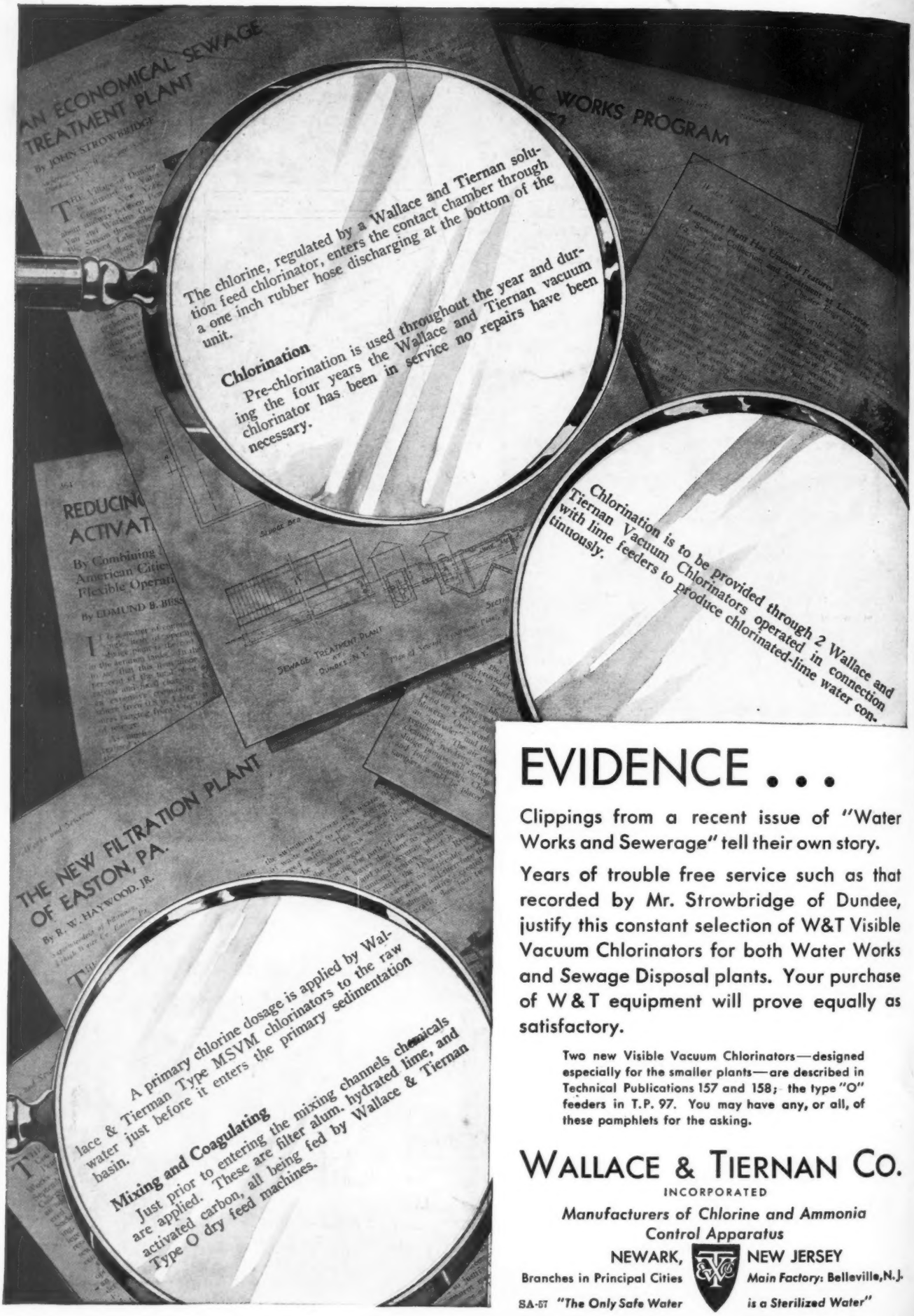
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